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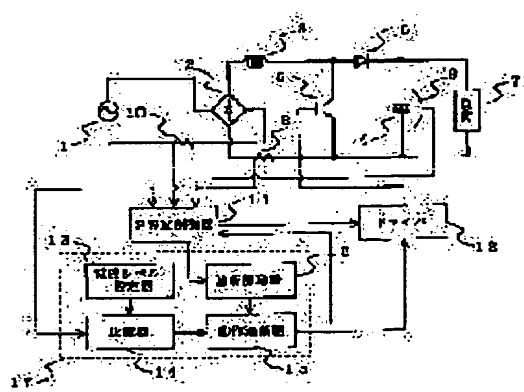
(54) PROTECTIVE CIRCUIT FOR PWM CONTROLLER

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a protective circuit which can protect the power factor improving circuit of a PWM controller without stopping the operations of the power factor improving circuit, when an overcurrent occurs in the power factor improving circuit.
SOLUTION: A protective circuit is provided with a PWM controller 11 having a switch element 5, a current detector which detects the current flowing to the controller 11, a current level setter 13 which sets the current to first and second current levels, a comparator 14 which compares the set current level values with detected current values, an operation interrupter 15 which interrupts the operation of the switch element 5 within one period of the carrier of the controller 11 when the current value is equal to or higher than the first current level and lower than the second current level, and an interruption canceler 16 which cancels the interrupting operation of the interrupter 15 whenever each cycle of the carrier is started. The interrupter 15 inhibits the interruption cancellation of the interruption canceler 16, when the detected current value is equal to or higher than the second input current level.



CLAIMS

[Claim(s)]
[Claim 1] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares the fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every when starting each period of said carrier.
[Claim 2] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd current level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled. Said breaker of operation The protection network of the PWM control unit with which the output of said comparator is characterized by forbidding cutoff discharge of said cutoff discharge machine when said detected current value is said more than 2nd input current level.
[Claim 3] The protection network of the PWM control unit according to claim 1 or 2 characterized by to have the control gain regulator with which the cutoff signal which stops actuation of a switching device in a breaker of operation at the time more than fixed current level outputs the period defined beforehand and the signal which is outputted continuously and lowers the control gain of an PWM controller at the time of slack to said PWM controller, and to reduce the count of cutoff of a switching device.
[Claim 4] In a breaker of operation above the 1st current level at the time under of said 2nd current level It is outputted continuously. the period which the cutoff signal which stops actuation of said switching device defined beforehand -- at the time of slack The protection network of the PWM control unit according to claim 1 or 2 characterized by having the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller, and reducing the count of cutoff of a switching device.
[Claim 5] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares the set point of this current level-setting machine with the current value detected by said current detector, and said detected current value are said more than fixed current level The protection network of the PWM control unit characterized by having the control gain regulator which lowers the control gain of an PWM controller.
[Claim 6] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the

2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.

[Claim 7] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, In the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit The protection network of the PWM control unit characterized by having the control gain regulator which lowers PWM control gain when said detected current value is more than fixed [said].

[Claim 8] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, In the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled.

[Claim 9] It is the protection network of the PWM control unit according to claim 3 to 8 which an PWM controller is equipped with the PI control section which carries out PWM control of the switching device, and is characterized by a control gain regulator outputting the signal to which either [at least] P gain of the PI control section or I gain is reduced.

[Claim 10] It is the protection network of the PWM control unit according to claim 3 to 8 which an PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device, and is characterized by a control gain regulator outputting the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced.

[Claim 11] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level The protection network of the PWM control unit characterized by having the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller may be lowered.

[Claim 12] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd current level, and said comparator The protection network of the PWM control unit characterized by having

the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.
[Claim 13] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every when starting each period of said carrier.
[Claim 14] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd voltage level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled. Said breaker of operation The protection network of the PWM control unit with which the output of said comparator is characterized by forbidding cutoff discharge of said cutoff discharge machine when said detected electrical-potential-difference value is said more than 2nd input voltage level.
[Claim 15] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the set point of this electrical-potential-difference level-setting machine with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level The protection network of the PWM control unit characterized by having the control gain regulator which lowers the control gain of an PWM controller.
[Claim 16] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd voltage level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd voltage level, and said comparator The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.
[Claim 17] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference detector which detects the electrical potential difference which flows to said PWM control device, and the electrical-potential-difference level-setting machine which sets up a fixed voltage level, With the comparator which compares said fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level The protection network of the PWM control unit

characterized by having the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller may be lowered.

[Claim 18] In the protection network of the PWM control unit which has the switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference which flows to said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd input voltage level, the output of the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd voltage level, and said comparator The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.

[Claim 19] The protection network of the PWM control unit according to claim 13, 14, 16, or 18 characterized by having the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller, and reducing the count of cutoff of a switching device when it is outputted continuously, the period when the cutoff signal which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level was defined beforehand, and.

[Claim 20] In a breaker of operation above the 1st voltage level at the time under of the 2nd voltage level The period when the cutoff signal which stops actuation of said switching device was defined beforehand, and when it is outputted continuously The protection network of the PWM control unit according to claim 13, 14, 16, or 18 characterized by having the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller, and reducing the count of cutoff of a switching device.

[Claim 21] It is outputted continuously. the period when the control gain accommodation signal which lowers the cutoff signal or control gain which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level was defined beforehand -- at the time of slack The protection network of the PWM control unit according to claim 13, 14, 16, or 18 characterized by having the amendment machine which outputs correction value to said PWM controller so that the command electrical-potential-difference value or command current value of an PWM controller may be lowered, and reducing the count of cutoff of a switching device.

[Claim 22] In a breaker of operation above the 1st voltage level at the time under of the 2nd voltage level It is outputted continuously. the period when the control gain accommodation signal which lowers the cutoff signal or control gain which stops actuation of said switching device was defined beforehand -- at the time of slack The protection network of the PWM control unit according to claim 13, 14, 16, or 18 characterized by having the amendment machine which outputs correction value to said PWM controller so that the command electrical-potential-difference value or command current value of an PWM controller may be lowered, and reducing the count of cutoff of a switching device.

[Claim 23] It is the protection network of the PWM control unit according to claim 15 to 22 which an PWM controller is equipped with the PI control section which carries out PWM control of the switching device, and is characterized by a control gain controller outputting the signal to which either [at least] P gain of the PI control section or I gain is reduced.

[Claim 24] It is the protection network of the PWM control unit according to claim 15 to 22 which an PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device, and is characterized by a control gain controller outputting the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced.

[Claim 25] The protection network of the PWM control unit according to claim 13 to 24 characterized by having the burden controller which outputs a signal to a load so that the load connected to the PWM control unit based on the output of a comparator may be increased.

[Claim 26] In the protection network of the PWM control unit which has one switching device which operates

based on the actuating signal from an PWM controller The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical potential difference detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level The protection network of the PWM control unit characterized by having the burden controller which outputs a signal to a load so that the load linked to an PWM control unit may be increased.

[Claim 27] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level Have the burden controller which outputs a signal to a load so that the load linked to an PWM control unit may be increased at the time under of said 2nd voltage level, and when said detected electrical-potential-difference value is more than the 2nd voltage level, the output of said comparator The protection network of the PWM control unit characterized by having the breaker of operation made to suspend actuation of said switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled.

[Claim 28] It is the protection network of the PWM control device according to claim 27 characterized by delaying the energization phase angle by which said inverter outputs said inverter controller to said motor in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load based on the signal outputted from a burden controller.

[Claim 29] It is the protection network of the PWM control device according to claim 27 characterized by making it make the rotational frequency at which said inverter outputs said inverter controller to said motor in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load increase based on the signal outputted from a burden controller.

[Claim 30] It is the protection network of the PWM control device according to claim 27 characterized by making it make the applied voltage with which said inverter outputs said inverter controller to said motor in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load increase based on the signal outputted from a burden controller.

[Claim 31] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The current detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the current which flows to said PWM control unit, The comparator which compares the current level-setting machine set as fixed current level with the fixed current level set up with this current level-setting vessel and the current value detected by said current detector, The protection network of the PWM control unit characterized by having the breaker of operation which maintains a halt of said switching device of said PWM controller of operation when said detected current value is said more than fixed current level.

[Claim 32] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The electrical-potential-difference detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the electrical potential difference which flows to said PWM control unit, The comparator which compares the electrical-potential-difference level-setting machine set as a fixed voltage level with the fixed voltage level set up with this electrical-potential-difference level-setting vessel and the electrical-potential-difference value detected by said electrical-potential-difference detector, The protection network of the PWM

control unit characterized by having the breaker of operation which maintains a halt of said switching device of said PWM controller of operation when said detected electrical-potential-difference value is said more than fixed voltage level.
[Claim 33] A laminate is the protection network of the PWM control unit according to claim 31 or 32 characterized by considering as the magnetic-substance ingredient whose thickness is the high permeability of 0.2mm or less.
[Claim 34] The protection network of the PWM control unit according to claim 33 characterized by arranging a door-post core and a transversal frame core so that the direction where magnetic flux flows may intersect perpendicularly with a transversal frame core and a door-post core using the quality of a magnetic matter which has directivity in a laminate.
[Claim 35] A connection is the protection network of the PWM control unit according to claim 31 to 34 characterized by making the edge of a transversal frame core and a door-post core into the field which makes the supplementary angle of each other to shaft orientations respectively.
[Claim 36] A connection is the protection network of the PWM control unit according to claim 31 to 34 characterized by considering as a right-angled end face to the shaft orientations of an parallel side face and the edge of a door-post core to the shaft orientations of the edge of a transversal frame core.
[Claim 37] The protection network of the PWM control unit according to claim 36 characterized by making the die length of a door-post core into a-2b when thickness of the rectangular direction of the plane of composition of a and a transversal frame core is set to b for the die length of a transversal frame core.
[Claim 38] The protection network of the PWM control unit according to claim 35 or 36 characterized by making a transversal frame core and a door-post core into the same die length.
[Claim 39] The protection network of the PWM control unit according to claim 31 to 38 characterized by making the coil of a pair into a juxtaposition volume.
[Claim 40] The protection network of the PWM control unit according to claim 31 to 38 characterized by making the coil of a pair into a serial volume.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the protection network which protects an PWM control unit from an overcurrent, without suspending actuation of an PWM control unit, when an overcurrent occurs with an PWM control unit. It is related with the protection network of the power circuit which performs a pressure up and performs the electric power supply to a load efficiently especially.
[0002]
[Description of the Prior Art] Drawing 40 is the block diagram of the power circuit of the conventional switching power supply shown in JP,8-103080,A, and drawing 41 is a block diagram of an overcurrent protection network which adds to the power circuit shown in drawing 40 , and prevents an overcurrent. In drawing 40 , it is the electrical-potential-difference detector with which diode for IC for PWM control which 1 gives AC power supply and the drive circuit where the capacitor for smooth, and 5 and 31 drive a switching device, and, as for 32, a full wave rectifier and 3 drive [2] switching devices 5 and 31 as for an inductance component, and 4 and 30 to the drive circuit 32, and 33 gives a driving signal, and 6 to prevent the back flow from a smoothing capacitor 4, and 39 detect a transformer, and 9 detects direct current voltage.
[0003] In drawing 41 , the resistance to which 34 was connected between the source of a switching device 31 and the negative terminal of a capacitor 4, the resistance whose 36 and 38 pressure partially the detection electrical potential difference in resistance 34, the capacitor from which 45 removes surge voltage, the resistance to which 35 was connected between the source of a switching device 5 and the negative terminal of a capacitor 4, the resistance whose 37 and 38 pressure partially the detection electrical potential difference in resistance 35, and 42 are the diodes inserted as an OR circuit.
[0004] Next, actuation is explained. First, in the power circuit of drawing 40 , if a control signal is inputted from IC33 for PWM control, a switching device 31 turns on the drive circuit 32 first, it is overdue only for T 1 hour, and a switching device 5 turns it on. Next, if the signal from IC33 for PWM control is lost, a switching device 5 turns off first, it is behind only for T 2 hours, and a switching device 31 turns off. Thus, two switching devices 31 and 5 are made to turn on and off, and the power-factor of an input current is improved.
[0005] Next, in the protection network of drawing 41 which adds to the power circuit shown in drawing 40 , and prevents an overcurrent, the current which flows to a switching device 31 flows resistance 34, and flows to AC power supply 1 through a rectifier 2. The electrical-potential-difference value by which the electrical potential difference occurred in resistance 34 when the current flowed to resistance 34, and the partial pressure was carried out by resistance 36 and resistance 38 is inputted into the current detection terminal of IC33 for PWM control. The current which flows to a switching device 5 similarly is detected by resistance 35, and the electrical-potential-difference value by which the partial pressure was carried out and the partial pressure was carried out by resistance 37 and resistance 38 is inputted into the current detection terminal of IC33 for PWM control. At the time more than constant value, this electrical-potential-difference value by which the partial pressure was carried out turns off a switching device 31 and a switching device 5, and protects from an overcurrent.
[0006] Moreover, drawing 41 is the power-factor-improvement circuit of a stone type pressure-up method of the single phase power source which was shown in JP,54-101148,A and which is generally known well. For a reactor and 4, as for a switching device and 6, in drawing 41 R> 1, a smoothing capacitor and 5 are [2 / a rectifier and 3 / the diode for antisuckbacks and 7] loads. Moreover, the power-factor-improvement circuit in

drawing 41 has a control-block Fig. as shown in drawing 43 . Drawing 43 is a control unit which controls the power-factor-improvement circuit of drawing 19 . For 47, as for a controller and 49, in drawing, a smoothing circuit and 48 are [a multiplier and 50] hysteresis comparators.
[0007] Actuation of the power-factor-improvement circuit and control unit which are shown in drawing 41 and drawing 43 is explained. In drawing 43 , target electrical-potential-difference U13soll produced in the output voltage and the smoothing capacitor 4 of a smoothing circuit 47 is led to a controller 48, and a controller 31 actually produces the controller output direct current voltage V according to a difference with a value with desired value. It multiplies by the controller output voltage V within a multiplier 49 with rectified network electrical-potential-difference |UN | by which smooth is not carried out. Output signal |UN |-V of a multiplier 49 is the output current i1 of a rectifier 2 within the hysteresis comparator 50. It is compared with the actual value to simulate and a switching device 5 is controlled according to the comparison result.
[0008] drawing 41 is resembled, it sets and input voltage in case a switching device 5 does not operate at all, and the relation of an input current serve as a wave form chart as shown in drawing 44 . Drawing 44 (a) is an input current wave form Fig., and drawing 44 (b) is an input voltage wave form chart. Only when the direct current voltage made smooth by the smoothing capacitor 4 is compared with the input voltage of the alternating current impressed by AC power supply 1, and the input voltage is higher than a direct-current bus-bar electrical potential difference, a current flows from AC power supply 1. Therefore, although an input current as shown in drawing 44 (b) flows, a lot of harmonic content contains in this current, and a power-factor also becomes a bad situation.
[0009] Then, if ON actuation of the switching device 5 as shown in drawing 41 is carried out, during ON of a switching device 5, it will pass along a full wave rectifier 2 and a reactor 3 from AC power supply 1, it will pass along a full wave rectifier 2 through a switching device 5, and the path of a current in which it flows to AC power supply 1 will be made. After a switching device 5 turns on, even if it makes a switching device 5 turn off, an input current continues flowing with the energy stored in the reactor 3. Although an input current flows with the energy stored in the reactor 3 at the time of OFF of a switching device 5, if an input current flows, the energy stored in the reactor 3 will decrease and an input current will also decrease with it. It is possible to control actuation of a switching device 5 and to make an input current into the shape of a sine wave using this property. Moreover, by detecting the phase of supply voltage with a phase detector 10, supply voltage and an input current in phase can be passed, and it becomes possible to control so that the input current shown in drawing 45 (b) to the input voltage shown in drawing 45 (a) as shown in an input current wave form Fig. flows.
[0010] Here, direct current voltage is also controllable by operating a switching device 5, and changing the amplitude value of a sine wave, although it is possible to control an input current in the shape of a sine wave. The energy stored in a reactor 3 changes and the electrical potential difference according to the amount of energy currently stored in the reactor 3 generates it to the both ends of a reactor 3. Therefore, since the aggregate value of the electrical potential difference of AC power supply 1 and the both-ends electrical potential difference of a reactor 3 is charged by the smoothing capacitor, it is 21/2 of the input voltage of AC power supply 1. Direct current voltage higher than twice can be outputted. Thus, it becomes possible to control an input current, and to make a power-factor improve, and to raise direct current voltage to adjustable.
[0011] Thus, when the power-factor is improved and an overvoltage occurs by carrying out pressure-up actuation, the power-factor-improvement circuit of a stone type pressure-up method stopped the switching device 5, and has protected the power-factor-improvement circuit from the overvoltage.
[0012] Moreover, drawing 47 is the iron core form reactor with a gap shown in JP,9-153416,A. For 81, as for a gap and 73, in drawing 47 , a coil, and 82 and 83 are [a leg and 72] the York iron cores. The frame-like core configuration of the reactor shown in drawing 47 R> 7 has the composition that the leg 81 for coils is formed in a square center section, and several place gap is prepared in the leg 81 for coils. A gap can raise the direct-current superposition property of a reactor, and can control a sudden overcurrent by acquiring a good direct-current superposition property.
[0013] Although it is the magnetic path generated from the coil 73 with which the York iron cores 82 and 83 have been arranged in the center in drawing 47 , it depends for the function of a reactor on the central leg 81, and the York iron cores 82 and 83 are determined with the dimension of a leg 81. Moreover, although the leg 81 has a gap 72, the gap 72 will be covered with a coil 73, and management of a gap turns into management of only bolting reinforcement.

[0014]
[Problem(s) to be Solved by the Invention] In two switching devices in a primary a transformer 39 side, the technique shown by JP,8-103080,A stabilizes direct current voltage, protects a circuit from an overcurrent, before stopping the switching device 5 which is carrying out pressure-up actuation, stops a switching device 31 and protects a circuit from an overcurrent.
[0015] The technique shown by JP,8-103080,A is very effective to the small application of output power like switching power supply. However, to the power source which needs large power like an air conditioner, for example, the current to which a normal state also flows to a switching device is large, and with it, the price of a switching device becomes high and it leads to a cost rise. Moreover, since loss by the switching device also becomes large and can serve as big technical problems, such as generation of heat, it is difficult to make a switching device into two pieces.
[0016] The technique shown in JP,54-101148,A is 21/2 of the input voltage of AC power supply 1. The direct current voltage which will be outputted if actuation of the switching device which is carrying out pressure-up actuation by protection by the overcurrent stops since it is the method which outputs direct current voltage higher than twice is 21/2 of input voltage. It falls twice and leads to malfunction of a load etc. For example, when the inverter which is carrying out electronics control is a load, if a power circuit suspends an inverter in order to operate so that the power which becomes fixed to the load linked to an inverter may be supplied, direct current voltage will fall, consequently the output current will be made to increase, and much more current will flow from AC power supply 1 to a power circuit through a rectifier 2.
[0017] Moreover, the electrical potential difference with an inverter more expensive than the direct current voltage usually impressed cannot be outputted. Many of loads connected to the inverter are motor loads, and a motor rotates at the rotational frequency according to the electrical-potential-difference value and frequency which are impressed, and generates torque. When the direct current voltage outputted from an PWM control unit rather than the electrical-potential-difference value which the motor load needs here becomes low, a motor stops reaching the rotational frequency to need. Therefore, an inverter will be detected with fault and will suspend actuation. With an inverter, when an inverter stops, if the load linked to an PWM control device operates an PWM control device, it can cause failure of not only failure of an PWM control device but an inverter. Therefore, it is necessary to enable it to recognize to an inverter the motor engine speed in which an output is possible according to direct current voltage, and the control system of an inverter becomes very complicated. Moreover, it is necessary to raise a direct-current superposition property and to protect an PWM control unit from a sudden overcurrent so that a reactor 3 cannot be saturated easily and may become.
[0018] Moreover, since the reactor 3 in the power-factor-improvement circuit of the pressure-up method of a stone type as shown in drawing 42 has the duty which direct current voltage is raised, and graduates an input current, and raises a power-factor by supplying energy to a smoothing capacitor 4 while the switching device 5 is carrying out ON actuation, energy is conserved and the switching device 5 turns off, it can be said that they are very important components.
[0019] When the reactor 3 used for this method is saturated, it stops functioning as a reactor and will become a load equivalent to resistance. Moreover, since a reactor 3 is the same as the condition of being the reactor 3 which turned into resistance and carrying out the power-source short circuit when it will become easy to be saturated if many currents flowed, this reactor 3 is saturated, and a switching device 5 turns on, a steep and big current flows a circuit top. If a reactor 3 escapes from a saturation state, it will return to normal operation and unchanging actuation.
[0020] Although the technique shown in JP,9-153416,A gives a gap 72 to a reactor and a good direct-current superposition property is acquired, in order that the iron core form reactor with a gap as shown in drawing 47 may form a gap 72 in the leg 81 which gives a coil, since a gap 72 is hidden by the coil 73, management of a gap 72 binds tight, it is only managed, and dispersion in the engine performance as a reactor becomes large.
[0021] Moreover, it is the coil of only the central leg 81, and since the York iron cores 82 and 83 are located on the outside, the whole dimension will become large. Furthermore, in case the magnetic flux generated in the central leg 81 passes through the outside York iron core, it branches to both in the node of a leg 81 and the York iron core 82, and cannot use the York iron cores 82 and 83 effectively.
[0022] Furthermore, since a coil is given only to a leg 81, the calorific value inside a coil will become very high, and the reactor engine performance by generation of heat will also get worse.

[0023] Moreover, although it is necessary to enlarge the total amount of gaps as a reactor if a direct-current superposition property tends to obtain a good reactor with the reactor which combines 2 sets for the core 76 of U typeface as shown in drawing 48 and which is often used conventionally, only two pieces can take a gap 73, but the gap per piece becomes large, and gap management becomes difficult. Furthermore, on the relation of bolting immobilization, a gap 73 will be hidden in a coil and has the problem that gap management will get worse more.
[0024] It is what was made in order that this invention might solve the above troubles. Also when an overcurrent occurs, the pressure up of the power circuit of an PWM control unit is performed. Moreover, without suspending actuation of the power circuit which the direct-current superposition property of a reactor etc. is raised and performs an electric power supply efficiently It consists of one switching device, and while obtaining the protection network which can protect the power-factor-improvement circuit of an PWM control unit from an overcurrent, it aims at offering a reliable power-factor-improvement circuit. (It is small, and especially about a reactor, in order to make a direct-current superposition property good, the total amount of gaps is enlarged, and further, it is that the amount of gaps per piece becomes small, and aims at reducing dispersion in a reactor.)
[0025]
[Means for Solving the Problem] The protection network of an involving-in this invention PWM control unit In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares the fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level It has the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every when starting each period of said carrier.
[0026] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd current level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled, and as for said breaker of operation, the output of said comparator forbids cutoff discharge of said cutoff discharge machine, when said detected current value is said more than 2nd input current level.
[0027] Furthermore, it has the control gain regulator with which the cutoff signal which stops actuation of a switching device in a breaker of operation at the time more than fixed current level outputs the period defined beforehand and the signal which is outputted continuously and lowers the control gain of an PWM controller at the time of slack to said PWM controller, and the count of cutoff of a switching device is reduced.
[0028] Moreover, it has the control gain regulator with which the cutoff signal which it is [signal] more than the 1st current level in a breaker of operation, and stops actuation of said switching device at the time under of said 2nd current level outputs the period defined beforehand and the signal which is outputted continuously and lowers the control gain of an PWM controller at the time of slack to said PWM controller, and the count of cutoff of a switching device is reduced.
[0029] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, It has the comparator which compares the set point of this current level-setting machine with the current value detected by said current detector, and the control gain regulator which lowers the control gain of an PWM controller when said detected current value is said more than fixed current level.
[0030] Moreover, it sets to the protection network of the PWM control unit which has one switching device

which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator It has the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.

[0031] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, In the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit When said detected current value is more than fixed [said], it has the control gain regulator which lowers PWM control gain.

[0032] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, In the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator It has the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled.

[0033] An PWM controller is equipped with the PI control section which carries out PWM control of the switching device, and a control gain regulator outputs the signal to which either [at least] P gain of the PI control section or I gain is reduced further again.

[0034] Moreover, an PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device, and a control gain regulator outputs the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced.

[0035] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level It has the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller may be lowered.

[0036] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd current level, and said comparator It has the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.

[0037] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level It has the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every when starting each period of said carrier.
[0038] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd voltage level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled, and as for said breaker of operation, the output of said comparator forbids cutoff discharge of said cutoff discharge machine, when said detected electrical-potential-difference value is said more than 2nd input voltage level.
[0039] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, It has the comparator which compares the set point of this electrical-potential-difference level-setting machine with the electrical-potential-difference value detected by said electrical-potential-difference detector, and the control gain regulator which lowers the control gain of an PWM controller when said detected electrical-potential-difference value is said more than fixed voltage level.
[0040] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd voltage level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd voltage level, and said comparator It has the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.
[0041] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference detector which detects the electrical potential difference which flows to said PWM control device, and the electrical-potential-difference level-setting machine which sets up a fixed voltage level, With the comparator which compares said fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level It has the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller may be lowered.
[0042] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference level-setting

machine set to the electrical-potential-difference detector which detects the electrical potential difference which flows to said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd input voltage level, the output of the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd voltage level, and said comparator It has the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted.

[0043] Moreover, the period when the cutoff signal which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level was defined beforehand, and when it is outputted continuously, it has the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller, and the count of cutoff of a switching device is reduced.

[0044] Furthermore, the period when the cutoff signal which stops actuation of said switching device in a breaker of operation at the time under of the 2nd voltage level above the 1st voltage level was defined beforehand, and when it is outputted continuously, it has the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller, and the count of cutoff of a switching device is reduced.

[0045] Moreover, the control gain accommodation signal which lowers the cutoff signal or the control gain which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level is equipped with the period defined beforehand and the amendment machine which output correction value to said PWM controller so that it may be outputted continuously and the command electrical-potential-difference value or the command current value of an PWM controller may be lowered at the time of slack, and the count of a switching device of cutoff reduces.

[0046] It sets to a breaker of operation further again. Above the 1st voltage level at the time under of the 2nd voltage level It is outputted continuously. the period when the control gain accommodation signal which lowers the cutoff signal or control gain which stops actuation of said switching device was defined beforehand -- at the time of slack It has the amendment machine which outputs correction value to said PWM controller so that the command electrical-potential-difference value or command current value of an PWM controller may be lowered, and the count of cutoff of a switching device is reduced.

[0047] Moreover, an PWM controller is equipped with the PI control section which carries out PWM control of the switching device, and a control gain controller outputs the signal to which either [at least] P gain of the PI control section or I gain is reduced.

[0048] Furthermore, an PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device, and a control gain controller outputs the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced.

[0049] Moreover, it has the burden controller which outputs a signal to a load so that the load connected to the PWM control unit based on the output of a comparator may be increased.

[0050] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical potential difference detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level It has the burden controller which outputs a signal to a load so that the load linked to an PWM control unit may be increased.

[0051] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference

outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level Have the burden controller which outputs a signal to a load so that the load linked to an PWM control unit may be increased at the time under of said 2nd voltage level, and when said detected electrical-potential-difference value is more than the 2nd voltage level, the output of said comparator It has the breaker of operation made to suspend actuation of said switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled.

[0052] Furthermore, in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load, said inverter controller delays the energization phase angle which said inverter outputs to said motor based on the signal outputted from a burden controller.

[0053] Moreover, it is made for said inverter controller to make the rotational frequency which said inverter outputs to said motor increase based on the signal outputted from a burden controller in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load.

[0054] It is made for said inverter controller to make the applied voltage which said inverter outputs to said motor increase based on the signal outputted from a burden controller in the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load further again.

[0055] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor moreover, said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The current detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the current which flows to said PWM control unit, The comparator which compares the current level-setting machine set as fixed current level with the fixed current level set up with this current level-setting vessel and the current value detected by said current detector, When said detected current value is said more than fixed current level, it has the breaker of operation which maintains a halt of said switching device of said PWM controller of operation.

[0056] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor furthermore, said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The electrical-potential-difference detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the electrical potential difference which flows to said PWM control unit, The comparator which compares the electrical-potential-difference level-setting machine set as a fixed voltage level with the fixed voltage level set up with this electrical-potential-difference level-setting vessel and the electrical-potential-difference value detected by said electrical-potential-difference detector, When said detected electrical-potential-difference value is said more than fixed voltage level, it has the breaker of operation which maintains a halt of said switching device of said PWM controller of operation.

[0057] Moreover, thickness uses a laminate as the magnetic-substance ingredient which is the high permeability of 0.2mm or less.

[0058] Using the quality of a magnetic matter which has directivity in a laminate, a door-post core and a transversal frame core are arranged further again so that the direction where magnetic flux flows may intersect perpendicularly with a transversal frame core and a door-post core.

[0059] Moreover, a connection makes the edge of a transversal frame core and a door-post core the field which makes the supplementary angle of each other to shaft orientations respectively.

[0060] Furthermore, a connection is taken as a right-angled end face to the shaft orientations of an parallel side face and the edge of a door-post core to the shaft orientations of the edge of a transversal frame core.

[0061] When you set thickness of the rectangular direction of the plane of composition of a and a transversal

frame core to b for the die length of a transversal frame core, let the die length of a door-post core be a-2b further again.
[0062] Moreover, let a transversal frame core and a door-post core be the same die length.
[0063] Moreover, let the coil of a pair be a juxtaposition volume.
[0064] Furthermore, let the coil of a pair be a serial volume.
[0065]
[Embodiment of the Invention]
Gestalt 1. drawing 1 of operation is the block diagram of the power circuit of the PWM control device in which the operation gestalt 1 of this invention is shown, and its protection network. The full wave rectifier which constituted 1 from AC power supply and constituted 2 from four diodes in drawing 1 , The direct current reactor for 3 conserving energy, carrying out the pressure up of the direct current voltage, and carrying out smooth [of the input current], A smoothing capacitor for 4 to carry out smooth [of the direct current voltage of the output of a power-factor-improvement circuit], The switching device for 5 switching between direct-current bus-bars, carrying out pressure-up actuation, making an input current into the shape of a sine wave, and improving a power-factor, The diode for back flow inhibition which prevents that a current flows backwards to a switching device 5 from a smoothing capacitor 4 when a switching device 5 turns on 6, The input current detector which detects the input current to which 7 flows for a load and 8 flows to a direct-current side, An PWM controller for the direct-current-voltage detector with which 9 detects direct current voltage, the phase detector with which 10 detects the electrical-potential-difference phase of AC power supply 1, and 11 to carry out PWM control of the switching device 5, and 12 are drivers which operate a switching device 5 based on the actuating signal from the PWM controller 11. The above configuration is the power-factor-improvement circuit of the DC-power-supply circuit of an PWM control unit.
[0066] Next, the configuration of the protection network 17 which protects a switching device 5 is explained, without stopping the actuation of a power circuit which is carrying out PWM control. The current level-setting machine with which 13 set up the 1st current level and the 2nd current level, the comparator with which 14 compares the set point of the current level-setting machine 13 and the current value detected with the input current detector 8, the breaker of operation which 15 makes intercept actuation of a switching device 5 by the result in a comparator 14, and 16 are a cutoff discharge machine of which cutoff of a switching device 5 is canceled, after intercepting actuation of a switching device 5 with the breaker 15 of operation.
[0067] Next, drawing explanation is given about actuation of the power-factor-improvement circuit shown in drawing 1 . Input voltage in case the switching device 5 shown in drawing 1 does not operate at all, and the relation of an input current serve as a wave form chart as shown in drawing 2 R> 2. Drawing 2 (a) is an input current wave form Fig., and drawing 2 (b) is an input voltage wave form chart. Only when the direct current voltage made smooth by the smoothing capacitor 4 is compared with the input voltage of the alternating current impressed by AC power supply 1, and the input voltage is higher than a direct-current bus-bar electrical potential difference, a current flows from AC power supply 1. Therefore, although an input current as shown in drawing 2 (b) flows, a lot of harmonic content contains in this current, and a power-factor also becomes a bad situation.
[0068] Then, if ON actuation of the switching device 5 as shown in drawing 1 is carried out, during ON of a switching device 5, it will pass along a full wave rectifier 2 and a reactor 3 from AC power supply 1, it will pass along a full wave rectifier 2 through a switching device 5, and the path of a current in which it flows to AC power supply 1 will be made. After a switching device 5 turns on, even if it makes a switching device 5 turn off, an input current continues flowing with the energy stored in the reactor 3. Although an input current flows with the energy stored in the reactor 3 at the time of OFF of a switching device 5, if an input current flows, the energy stored in the reactor 3 will decrease and an input current will also decrease with it. It is possible to control actuation of a switching device 5 and to make an input current into the shape of a sine wave using this property. Moreover, by detecting the phase of supply voltage with a phase detector 10, supply voltage and an input current in phase can be passed, and it becomes possible to control so that the input current shown in drawing 3 (b) to the input voltage shown in drawing 3 (a) as shown in an input current wave form Fig. flows.
[0069] Here, direct current voltage is also controllable by operating a switching device 5, and changing the amplitude value of a sine wave, although it is possible to control an input current in the shape of a sine wave. That is because the energy stored in a reactor 3 changes, the electrical potential difference according to the

amount of energy currently stored in the reactor 3 occurs to the both ends of a reactor 3 and the aggregate value of the electrical potential difference of AC power supply 1 and the both-ends electrical potential difference of a reactor 3 can charge a smoothing capacitor. Thus, a power-factor is made to improve, generally the power-factor-improvement circuit of the pressure-up method which raises direct current voltage is known, and makes an input current the shape of a sine wave, and the PWM controller 11 in drawing 1 carries out PWM control of the switching device 5 so that direct current voltage may be controlled to any value.
[0070] Next, actuation of a protection network 17 is explained. First, the 1st current level and the 2nd current level are explained. Usually, only the 2nd current level is set up as protection of a switching device 5. It is the purpose to protect this 2nd current level from a switching device 5 being damaged, when the maximum current value which a switching device 5 does not damage is set up and a bigger current than the 2nd current level flows to a switching device 5.
[0071] The 1st current level is set as a value lower than the 2nd current level. It is not the purpose to protect from a switching device 5 damaging this 1st current level according to an excessive current. This 1st current level sets up some as a large value rather than the maximum rating current value of a load, and before it reaches the level which a switching device 5 damages, it protects the whole circuit from an excessive current temporarily.
[0072] By the way, since the reactor 3 in the power-factor-improvement circuit of the pressure-up method of this stone type has the duty which contributes to a pressure up and carries out smooth [of the current], it can be said that they are very important components. The more current capacity becomes large, the more the reactor 3 used for this method becomes what has a small inductance value. A reactor 3 will become easy to be saturated if an inductance value becomes small. When a reactor 3 is saturated, it stops functioning as a reactor 3, and will become a load equivalent to resistance.
[0073] Since it is the same as the condition of carrying out the power-source short circuit with the reactor 3 which turned into resistance when this reactor 3 is saturated, and a switching device 5 is turned on, a steep and big current flows a circuit top. If a reactor 3 escapes from a saturation state, it will return to normal operation and unchanging actuation. In this way, when a reactor 3 will be in a saturation state, the 1st current level prevents a switching device 5 turning on, and it sets it up so that actuation of a power-factor-improvement circuit may not be stopped. Moreover, before reaching the level which a switching device 5 damages, it is also the purpose to protect the whole circuit from an excessive current temporarily.
[0074] Next, the flow chart Fig. of drawing 4 explains actuation of a protection network 17. A switching device 5 is working (S1), and a comparator 14 compares the 1st current level and input current value which were set up with (S2) and the current level-setting vessel 13 when it was not carrier start time. First, above the 1st current level When the current value of under said 2nd current level is flowing, in order to suspend actuation of (S3) and a switching device 5, a cutoff signal is outputted to a driver 12 with the breaker 15 of operation. And actuation of a switching device 5 is stopped (S4). Protected operation is not performed when a current value is smaller than the 1st current level.
[0075] This cutoff actuation is continued until the following carrier period starts. That is, actuation of a switching device 5 has stopped within the same carrier. As for discharge of cutoff actuation, synchronizing with the start time of a carrier period, a signal is inputted into the cutoff discharge machine 16 from the PWM controller 11 at the time of carrier initiation. The cutoff discharge machine 16 cancels cutoff actuation of the breaker 15 of operation for every carrier period (S5). The wave which shows the situation of actuation of this single string is shown in drawing 5 . When the 1st current level guard signal shown in drawing 5 (b) is outputted, as shown in drawing 5 (e), the actuating signal of a switching device stops, and actuation of a switching device is started with the 1st current level protection discharge signal which is outputted for every start time of carrier 1 period of the actuating signal from the PWM controller 11 shown in drawing 5 (a) and which is shown in drawing 5 R> 5 (c). Thus, when the 1st current level is exceeded, only the remaining time amount of the carrier period which is carrying out PWM control suspends actuation of a switching device 5.
[0076] Next, cutoff on the 2nd current level is explained. It does not have profit with a logic top that the excessive current which originates in a switching device 5 and flows on the 1st current level since actuation of a switching device 5 is suspended temporarily reaches the 2nd current level. However, since possibility of being the fault of a switching device is high when also exceeding the 2nd current level in slight time amount after exceeding the 1st current level until it suspends actuation of a switching device 5, it is a problem to operate a

switching device 5.
[0077] Then, the cutoff discharge machine 16 cannot cancel cutoff actuation of the switching device 5 in carrier period start time as it is shown in drawing 5 (d), when the 2nd current level is exceeded (S6). With the output signal from the breaker 15 of operation to the PWM controller 11, the actuating signal of the switching device 5 in the PWM controller 11 is stopped as shown in drawing 5 (a), from ** (S7), the cutoff discharge machine 16 cancels halt actuation (S8), and a power-factor-improvement circuit is rebooted. Or halt actuation is canceled, only when troubleshooting mode etc. is added to equipment and it becomes clear that it is not failure for example. In addition, in drawing 4 , with the actuating signal of the PWM controller 11 to a switching device, only the inside of a carrier period considers the case where switching is suspended as cutoff, and the case where there is no output of the actuating signal of the PWM controller 11 to a switching device, and switching is suspended is considered as a halt.
[0078] Although the 1st current level and the 2nd current level are prepared as mentioned above and power-factor-improvement circuits including a switching device 5 are protected, it avoids suspending actuation of a power-factor-improvement circuit because it is [following] reasonable. First, if actuation is realized and actuation of DC power supply stops the DC power supply which carry out circuitry as shown in drawing 1 by carrying out the pressure up of the direct current voltage, direct current voltage will fall to the amplitude value of AC power supply 1. As a load, when the inverter is connected to this PWM control unit, fault occurs by direct-current-voltage fall.
[0079] And the inverter is operating by electronics control and operates the load connected to the inverter using the power usually inputted as the direct current voltage impressed. To the load connected to the inverter, an inverter operates so that fixed power may be supplied. Here, if direct current voltage falls, in order to supply the same power, an inverter operates so that many currents may be outputted. Moreover, when actuation of a power-factor-improvement circuit stops, the current which a power-factor declines extremely, therefore flows in a power-factor-improvement circuit becomes large, and the bigger peak current will be inputted from AC power supply 1 by having suspended actuation. An inverter also cannot but cause failure and cannot but suspend an inverter and actuation because the output current of an inverter also becomes large.
[0080] Therefore, on the 1st current level which is not the level which a switching device 5 damages as mentioned above, without suspending actuation of a power-factor-improvement circuit by forming the protection network 17 which carries out protected operation which stops a switching device 5 temporarily, it becomes possible to protect a power-factor-improvement circuit from an overcurrent, and a reliable power-factor-improvement circuit can be offered. Moreover, also by the overcurrent generated in the saturation by components dispersion of a reactor, a halt of a power-factor-improvement circuit of operation can be prevented, and a reliable power-factor-improvement circuit can be offered. Moreover, it can prevent damaging [******] a switching device, with actuation of a switching device 5 suspended at the time more than the 2nd current level.
[0081] Gestalt 2. drawing 6 of operation is the block diagram of the protection network of the PWM control device in which the gestalt 2 of implementation of this invention is shown. In drawing, the agreement same identically to drawing 1 of gestalt drawing 1 of operation as a considerable part is attached, and explanation is omitted. 18 is a control gain regulator which receives the signal from the breaker 15 of a protection network 17 of operation, and changes the control gain of the PWM controller 11.
[0082] Next, the flow chart Fig. of drawing 7 explains actuation of a protection network 17. Actuation (S11-S14, S17) when a current value reaches the 1st current level is the same as the actuation (S1 - S4, S5) shown in drawing 4 of the gestalt 1 of operation. Moreover, the point that actuation (S18-S20) when a current value reaches the 2nd current level is the same as the actuation (S6-S8) shown in drawing 4 of the gestalt 1 of operation, and the gestalt 1 of operation differs from actuation A period with the current which reaches the 1st current level, and when flowing continuously (S15), it is the point of reducing the control gain in PWM control with the control gain regulator 18 (S16).
[0083] It is presumed to be too large [control gain] to the current value which the reactor is saturated or flows as above-mentioned that the current value exceeding the 1st current level flows continuously. Among the time amount of for example, about 25% of a power-source half period, when the overcurrent exceeding the 1st current level is detected continuously, it is this purpose to reduce the control gain of the PWM controller 11 and to reduce the amount of currents which flows by control there.
[0084] If it is the control which what kind of control system may be used for, and will affect PWM of a

switching device 5 by reducing the control gain of these control systems if it is the control which carries out PWM control here, it cannot be overemphasized that what kind of control system may be used. For example, P control, PI control, PID control, etc. are mentioned as these PWM control systems.
[0085] During the above-mentioned passage, for example, the time amount of about 25% of a power-source half period, when the current exceeding the 1st current level is detected continuously, the control gain of the PWM controller 11 is reduced about 5% rather than the present value. Here, it may not be 5% to make it fall, and although 3% or 10% are sufficient, if too small [if it is rapidly made small, a control system will oscillate and it will malfunction, and], since the effectiveness of a gain fall will be lost, about 5% is just right level. And when cutoff of switching by the 1st current level starts continuously as shown in the flow chart of drawing 7 R> 7, the control gain of the PWM controller 11 is reduced. Moreover, generally control gain is usually used for the operation in S/W, and a control gain fall can be realized by changing the multiplier of gain on data processing.
[0086] Moreover, when a load 7 turns into a light load, consequently a detection current value becomes small sharply from the 1st current level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.
[0087] By adding the control gain regulator 18, modification to the control gain according to the flowing current value is attained, and the PWM command of the PWM controller 11 falls, therefore ON actuation of a switching device 5 is reduced. Therefore, since the input current detected with the input current detector 8 since the input current which flows from AC power supply 1 is reduced also stops also exceeding the 1st current level and actuation of a switching device 5 is not stopped in a protection network 17, supply becomes possible from the technique explained with the gestalt 1 of implementation of invention to a load 7 about the direct current voltage which the control system was stabilized and was stabilized more. Furthermore, since compulsory cutoff with the breaker 15 of operation is lost, by actuation of a protection network 17, it becomes possible to bring the distorted input current close in the shape of a sine wave more, and contributes to much more power factor improvement.
[0088] The gestalt 3 of gestalt 3. implementation of operation shows the concrete method of changing gain, when the PWM controller 11 in the gestalt 2 of operation is equipped with the PI control section. The configuration of a protection network is the same as drawing 6 of the gestalt 2 of operation, and drawing 8 is the control-block Fig. showing the PI control of the PWM controller 11. It consists of two control block of the PI control of the current for controlling the PI control and input current of an electrical potential difference for controlling direct current voltage in drawing.
[0089] First, control of the power-factor-improvement circuit at the time of using PI control is explained. The direct-current-voltage detection value detected with the direct-current-voltage detector 9 in drawing 1 , the input current detection value detected with the input current detector 8 and the phase detected with the phase detector 10, and a sin curve in phase are used for the control in drawing 8 .
[0090] Although it is the PI control of the electrical potential difference in drawing 8 , the value which carried out the multiplication of the difference which the difference of a storing [in the target PWM controller 11] direct-current-voltage command value and a direct-current-voltage detection value was first computed, and was computed to the proportional gain value KV1 of an electrical potential difference serves as a proportional. Moreover, the value adding the value which carried out the multiplication of the computed difference to the integral gain value KV2 of an electrical potential difference, and the aggregate value of the multiplication value to last time serves as an integral term. The value adding this proportional and an integral term is a control output value of PI control, and, generally it is known that controlling by the above control output values is PI control.
[0091] Here, it multiplies by the output value in the PI control of an electrical potential difference with sintheta with a multiplier. The output of this multiplier serves as a command value of a target current. This SIN curve turns into an electrical-potential-difference phase and a SIN curve in phase with the phase detector 10 which detects the electrical-potential-difference phase of AC power supply 1.
[0092] The current command value outputted with this multiplier and the input current detection value detected with the input current detector 8 are used by the PI control of a current. Like [the PI control of a current] the PI control of an electrical potential difference, a proportionality component and an integral component are computed and the PWM output value which carries out PWM control of the switching device 5 is acquired from those sums as shown in drawing 8 from the difference of a current command value and an input current detection value. This PWM output value is inputted into the driver 12 in drawing 2 , and operates a switching

device 5.

[0093] Next, actuation of the gestalt of this operation is explained. Although actuation is the same as that of the flow chart of drawing 7 of the gestalt 2 of operation and it is the approach of carrying out the control gain fall of the PWM control 11 (S16) For example, during the period of 25% of a power-source half period, although a control gain value is reduced 5% when the 1st current level is exceeded continuously, the control gain value in the PI control shown by drawing 8 reduces KV1, KV2, KI1, KI2, those with four piece, and at least one or more gain values.

[0094] That is, when [that there is a current value which reaches the 1st current level] period continuation is carried out and it is detected, it restricts, when there is two control gain to reduce, and either or both are reduced.

[0095] Moreover, although the control gain to reduce has the gain value of the PI control of an electrical potential difference, and the PI control of a current as shown in drawing 8 , it may reduce the control gain of either and both. Moreover, although either [at least] P gain or I gain may be reduced, it is early that the effectiveness of a gain fall of the direction where the P gain lowers P gain from I gain since immediate effect nature is high appears.

[0096] As mentioned above, by adding the control gain regulator 18, modification to the control gain according to the flowing current value is attained, and the PWM command of the PWM controller 11 falls, therefore ON actuation of a switching device 5 is reduced. Therefore, since the input current detected with the input current detector 8 since the input current which flows from AC power supply 1 is reduced also stops also exceeding the 1st current level and actuation of a switching device 5 is not stopped in a protection network 17, supply becomes possible from the technique explained with the gestalt 1 of operation to a load 7 about the direct current voltage which the control system was stabilized and was stabilized more. Furthermore, since prohibition of actuation of the switching device 5 by the protection network 17 is lost, by actuation of a protection network 17, it becomes possible to bring the distorted input current close in the shape of a sine wave more, and a power-factor can be improved further.

[0097] Moreover, when a load 7 turns into a light load, consequently a detection current value becomes small sharply from the 1st current level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.

[0098] Gestalt 4. drawing 9 of operation is the block diagram of the protection network of the PWM control device in which the operation gestalt 4 of this invention is shown. In drawing, the same agreement is given to the drawing 6 identitas or the considerable part of a gestalt 2 of operation, and explanation is omitted. With this operation gestalt, the breaker 51 of operation in drawing serves to stop a switching device 5, when the 1st current level is exceeded, actuation of a switching device 5 is not intercepted and the 2nd current level is exceeded. Moreover, the control gain regulator 18 serves to reduce control gain, when the 1st current level is exceeded.

[0099] Next, the flow chart of drawing 10 explains the actuation in this operation gestalt. First, a switching device 5 is operated with the PWM controller 11 (S31). And the input current detected with the input current detector 8 is compared with the 1st current level by the comparator 14 (S32). When the input current detected rather than the 1st current level is small, a power-factor-improvement circuit operates without changing the control gain in the PWM controller 11. However, when the input current detected rather than the 1st current level is large, the control gain regulator 18 reduces the control gain of the PWM controller 11, and carries out PWM actuation of the switching device 5 (S33).

[0100] Next, the input current detected with the input current detector 8 is compared with the 2nd current level by the comparator 14 (S34). When the 2nd current level is exceeded, the breaker 51 of operation outputs a signal so that actuation of a switching device 5 may be suspended to a driver 12 (S35). The cutoff of operation at the time of exceeding the 2nd current level is canceled by the PWM controller 11 only during a halt of a switching device 5 of operation (S36). This is because the semantics stopped exceeding the 2nd current level will be lost if actuation of the breaker 51 of operation is canceled when the actuating signal from the PWM controller 11 to a switching device 5 is outputted. Since the control gain of the PWM controller 11 is reduced when the 1st current level is exceeded, an PWM output value declines, therefore ON actuation of a switching device 5 is reduced.

[0101] As mentioned above, since control gain falls, the input current which flows from AC power supply 1 is

reduced, it stops also exceeding the 1st current level, a control system is stabilized by the input current detected with the input current detector 8, and supply of it is attained to a load 7 in the stable direct current voltage. Furthermore, without suspending actuation of a power-factor-improvement circuit, it becomes possible to protect a power-factor-improvement circuit from an overcurrent, and a reliable power-factor-improvement circuit can be offered.

[0102] Moreover, when changing control gain, it is not necessary to say that the same effectiveness as the above can be acquired by changing one [at least] control gain of an electrical potential difference and a current. Moreover, as PWM control, when PI control is used, the control gain to reduce has the gain value of the PI control of an electrical potential difference, and the PI control of a current, as shown in drawing 8 , but even if it reduces the control gain of either and both, it cannot be overemphasized that there is the effectiveness. Moreover, although either [at least] P gain or I gain may be reduced, it is early that the effectiveness of a gain fall of the direction where the P gain lowers P gain from I gain since immediate effect nature is high appears.

[0103] Furthermore, when a load 7 turns into a light load and a detection current value becomes small sharply from the 1st current level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.

[0104] The gestalt of gestalt 5. book implementation of operation changes actuation of the control gain regulator of the gestalt 4 of operation. The block diagram of a protection network is the same as the block diagram of drawing 9 , and explains actuation of the gestalt of this operation with the flow chart of drawing 11 . A switching device 5 is working (S41), and a comparator 14 compares the 1st current level and input current value which were set up with the current level-setting vessel 13 (S42). First, above the 1st current level Only when the current value of under said 2nd current level is flowing and the time of day which had exceeded is near the peak of the sine wave of supply voltage, the control gain regulator 18 works so that control gain may be reduced (S46). For example, when the half period of the sinusoidal voltage of AC power supply 1 is made into 180 degrees, a fixed period with near the peak of a sine wave is set up with 120 degrees from 60 degrees. When it is the 60-degree section which goes into 120 degrees from these 60 degrees and the input current is over the 1st current level, PWM control action of the switching device 5 is carried out in the state of the control gain which the control gain regulator 18 reduced the control gain of the PWM controller 11, and fell.

[0105] When reducing control gain near a peak (S46), the control gain regulator 18 operates so that control gain may be raised, after passing through near a peak (S45). Thus, since supply voltage is an alternating current, near a peak and near a zero cross, by the flowing instantaneous-carrying-current values differing and setting up the control gain according to the flowing current, an input current can approach a sine wave more and a power-factor can be improved. Moreover, the responsibility near a peak is dropped, and since an overcurrent is usually produced near a peak, it is hard coming to generate an overcurrent by raising a response near a zero cross. Moreover, when performing the above control, since the effectiveness that a control system is stabilized further and an input current approaches a sine wave more is brought about even if it sets up the 1st [according to a burden] current level, it is satisfactory even if it changes the 1st current level in the middle of actuation of an PWM control device.

[0106] Next, the input current detected with the input current detector 8 is compared with the 2nd current level by the comparator 14 (S47). When the 2nd current level is exceeded, the breaker 51 of operation outputs a signal so that actuation of a switching device 5 may be suspended to a driver 12 (S48).

[0107] As mentioned above, by adding the above functions to the control gain regulator 18, the control gain according to a burden and the flowing instantaneous-carrying-current value can be set up, by it, a control system can be made stability and a power-factor can be raised further. Furthermore, the peak current is suppressed, and it becomes possible to prevent an overcurrent, without suspending actuation of a power-factor-improvement circuit, and a reliable power-factor-improvement circuit can be offered.

[0108] Moreover, when changing control gain, the same effectiveness as the above can be acquired by changing one [at least] control gain of an electrical potential difference and a current. Moreover, as PWM control, when PI control is used, as shown in drawing 8 , there is a gain value of the PI control of an electrical potential difference and the PI control of a current, but even if the control gain to reduce reduces the control gain of either and both, it has the effectiveness. Moreover, although either [at least] P gain or I gain may be reduced, it is early that the effectiveness of a gain fall of the direction where the P gain lowers P gain from I gain since immediate effect nature is high appears.

[0109] Gestalt 6. drawing 12 of operation is the block diagram of the protection network of the PWM control device in which the operation gestalt 6 of this invention is shown. In drawing, the agreement same identically to drawing 9 of the gestalt 4 of operation as a considerable part is attached, and explanation is omitted. In drawing, 19 is an amendment machine which adds amendment to the command current of the PWM controller 11 by the comparator 14 when a detection current is larger than the 1st current level.
[0110] When the amendment machine 19 had the input current value larger than the 1st current level at the comparator 14 and it is compared, amendment is added to the current value made into the target which is carrying out PWM control with the PWM controller 11. Since the flowing amount of currents is large, this tends to reduce the target current value itself and tends to reduce the flowing amount of currents. Since a switching device 5 is controlled and a current flows so that a target current may be approached, the amount of currents which flows in a switching device 5 operating is also reduced, and the PWM controller 11 can be avoided from overcurrent level, if a target current becomes small.
[0111] Moreover, although PI control serves as a control-block Fig. shown by drawing 8 as PWM control when PI control is applied, the control-block Fig. of the PI control of a current which added amendment with the amendment machine 19 serves as drawing 13 . Drawing 13 amends by changing with the control-block part of the PI control of the current which shows the relation of the multiplier in the PWM controller 11 interior, and the PI control of a current and the amendment machine 19, and is shown in drawing 8 .
[0112] In the control-block Fig. in drawing 8 , the output value outputted from the multiplier is a command value of the current used for the PI control of a current, and serves as a target current in the above. Therefore, the input current value and the 1st current level which are detected with the input current detector 8 by the comparator 14 in drawing 12 are compared, and when the input current value becomes large rather than the 1st current level, in the amendment machine 19, amendment is added to the command value of the current inputted into the PI control machine of a current. In drawing 13 , the part which applies the output of a multiplier and the output of an amendment machine is an amendment part stated with the gestalt of this operation. Since the command value of a current turns into a small value [before amending] and a target current becomes small by this amendment, the PWM output value from the PI control of a current becomes small, and ON actuation of a switching device 5 also becomes small, and it is amended so that the input current which flows by actuation of a switching device 5 may be reduced and control may operate.
[0113] As mentioned above, without completely stopping actuation of the power-factor-improvement circuit itself by adding the amendment machine 19, it becomes possible to protect a power-factor-improvement circuit from an overcurrent, and a reliable power-factor-improvement circuit can be offered.
[0114] Moreover, although amendment tended to be added to the command value of a current and it was going to protect from the overcurrent, even if it adds amendment to the command value of the electrical potential difference in drawing 8 , there is same effectiveness.
[0115] In addition, when the 2nd current level is exceeded, the actuation of which actuation of a switching device 5 is stopped and this halt is canceled is the same as the gestalt 5 of operation. Furthermore, control gain is not reduced, although control gain was continuously reduced with the gestalt 1 of operation at the time of the 1st current level ******, even if it carries out similarly the method which adds amendment, it is satisfactory in any way, and it is ****** about effectiveness equivalent to the gestalt 1 of operation.
[0116] Gestalt 7. drawing 14 of operation is the block diagram which added the protection network shown in the gestalten 1-6 of operation to the inverter circuit which is carrying out general PWM control which shows the gestalt 7 of operation. The inverter PWM controller with which 20 controls six inverters and 21 controls an inverter 20, the inverter driver with which 22 operates an inverter 20, and 23 are the motors of the load connected to the inverter 20.
[0117] Although the gestalten 1-6 of operation were applied and stated to the power-factor-improvement circuit of a single-phase pressure-up method, even if it applies to six inverters which carry out general PWM control and are operated, circuit actuation cannot be suspended, but it can protect from an overcurrent, and even if it applies to an inverter, it has the same effectiveness as a power-factor-improvement circuit. Moreover, it is applicable about all the circuits that carry out PWM actuation.
[0118] Although the gestalten 1-7 of gestalt 8. implementation of operation prepared the 1st current level and the 2nd current level and protected them from the overcurrent of equipment about the overcurrent protection, the 1st voltage level and 2nd voltage level are prepared instead of a current, and the gestalt of the following

operations explains what protected equipment from the overvoltage. The gestalt of this operation is drawing 1 in the gestalt 1 of operation, replaces the current level-setting machine 13 with an electrical-potential-difference level-setting machine, and considers it as the configuration which inputted the signal of the electrical-potential-difference detector 9 at a comparator 14.

[0119] Drawing 15 is the block diagram of the power circuit of the PWM control device in which the operation gestalt 8 of this invention is shown, and its protection network. In drawing 15 , the agreement same identically to drawing 1 in the gestalt 1 of operation as a considerable part is attached, and explanation is omitted. The electrical-potential-difference level-setting machine with which 61 set up the 1st voltage level and 2nd voltage level, and 14 are comparators which compare the set point of the electrical-potential-difference level-setting machine 61 with the electrical-potential-difference value detected with the direct-current-voltage detector 9.

[0120] Next, actuation is explained. Actuation of the power-factor-improvement circuit shown in drawing 15 is the same as actuation of the gestalt 1 of operation, raises direct current voltage and improves a power-factor. The PWM controller 11 makes an input current the shape of a sine wave, and it carries out PWM control of the switching device 5 so that direct current voltage may be controlled to any value.

[0121] Next, actuation of a protection network 17 is explained. First, the 1st voltage level and 2nd voltage level are explained. Usually, only the 2nd voltage level is set up as protection of a switching device 5. It is the purpose that this 2nd voltage level protects from a switching device 5 or a smoothing capacitor 4 being damaged by setting up the maximum electrical-potential-difference value determined by pressure-proofing of a switching device 5 or pressure-proofing of a smoothing capacitor 4, and impressing an electrical potential difference higher than the 2nd voltage level to an PWM control device.

[0122] The 1st voltage level is set as a value lower than the 2nd voltage level. It is not the purpose to protect from a switching device 5 or a smoothing capacitor 4 damaging this 1st voltage level with overvoltage. This 1st voltage level sets up some as a large value rather than the direct-current-voltage value which a load needs, and before it reaches the level which a switching device 5 or a smoothing capacitor 4 damages, it protects the whole circuit from overvoltage temporarily.

[0123] Next, the flow chart Fig. of drawing 16 explains actuation of a safeguard 17. First, when the switching device 5 was working (S51), a comparator 14 compares the 1st voltage level and direct-current-voltage value which were set up with (S52) and the electrical-potential-difference level-setting vessel 61 when it is not carrier start time, and the electrical-potential-difference value higher than the 1st voltage level is outputted (S53), in order to suspend actuation of a switching device 5, a cutoff signal is outputted to a driver 12 with the breaker 15 of operation. And actuation of a switching device 5 is stopped (S54). Protected operation is not performed when an electrical-potential-difference value is lower than the 1st voltage level.

[0124] This cutoff actuation is continued until the following carrier period starts. That is, within the same carrier, when actuation of a switching device 5 is suspended once, a switching device 5 remains stopping.

[0125] Synchronizing with the time of day of a carrier period when it starts (S52), as for discharge of this cutoff actuation, a signal is inputted into the cutoff discharge machine 16 from the PWM controller 11. The cutoff discharge machine 16 cancels cutoff actuation of the breaker 15 of operation for every carrier period (S55). If the wave which shows the situation of actuation of this single string is the same as what is shown in drawing 5 of the gestalt 1 of operation and the 1st voltage-level guard signal shown in drawing 5 (b) is outputted, even if the actuating signal of the PWM controller 11 shown in drawing 5 (a) is outputted, the actuating signal to the switching device 5 shown in drawing 5 (e) is inputted so that a switching device 5 may not operate. And actuation of a switching device 5 is started with the 1st voltage-level protection discharge signal shown in drawing 5 (c) outputted for every start time of carrier 1 period of the actuating signal from the PWM controller 11 shown in drawing 5 (a).

[0126] Thus, when the 1st voltage level is exceeded, only the remaining time amount of the carrier period which is carrying out PWM control suspends actuation of a switching device 5.

[0127] Next, a halt with the 2nd voltage level is explained. Since actuation of a switching device 5 is suspended temporarily, if the PWM controller 11 is controlling the switching device 5 by the 1st voltage level normally, it does not have profit with a logic top that the direct current voltage to output reaches the 2nd voltage level. However, when the load 7 connected to the PWM control device is not operating, the charge is stored little by little in the smoothing capacitor 4 in slight time amount after exceeding the 1st voltage level until it suspends actuation of a switching device 5, without the charge stored in the smoothing capacitor 4 discharging. By this

pile, direct current voltage may exceed the 2nd voltage level.
[0128] Here, since it is the case of possibility of being the fault of the PWM controller 11 or the direct-current-voltage detector 9 when the load 7 is not operating as mentioned above when exceeding the 2nd voltage level, it is not necessary to operate an PWM control unit.
[0129] Then, the cutoff discharge machine 16 cannot cancel cutoff actuation of the switching device 5 in carrier period start time as it is shown in drawing 5 (d), when the 2nd voltage level is exceeded (S56). The signal which shows that it is the 2nd voltage level from the breaker 15 of operation is inputted into the PWM controller 11, and the actuating signal from the PWM controller shown in drawing 5 (a) is stopped (S57). Then, the cutoff discharge machine 16 is made to cancel halt actuation of a switching device 5 (S58).
[0130] or -- for example, only when troubleshooting mode etc. is added to equipment and it becomes clear that it is not failure, halt actuation of a switching device 5 is canceled -- it is made like (S58).
[0131] In addition, in drawing 16 , it considers as cutoff that only the inside of a carrier period suspends switching for the actuating signal of a switching device 5 from the PWM controller 11 with the 1st voltage level, and is considering stopping switching of a switching device 5 continuously with the 2nd voltage level as a halt.
[0132] Preparing the 1st voltage level and 2nd voltage level as mentioned above, and avoiding suspending actuation of a power-factor-improvement circuit, although protected without stopping power-factor-improvement circuits including a switching device 5 as much as possible also has the following reasons besides the fault generated in the inverter in the technical problem described above, when the inverter is connected as a load.
[0133] When the inverter which drives a motor as a load is connected to the PWM control device which carries out circuitry as shown in drawing 15 , a motor load can carry out efficient operation by making it operate with necessary minimum applied voltage. That is because loss depending on the carrier frequency component in an inverter is reduced. Therefore, since the ratio of the direct current voltage inputted into an inverter and the alternating voltage outputted from an inverter can carry out efficient operation of the motor more, its way near 1 as much as possible is desirable.
[0134] Therefore, when the inverter which drives a motor by restricting the direct current voltage inputted into an inverter with the 1st voltage level which is not the level which protection needs is connected as a load, a load can be operated efficient. Moreover, also in the power-factor-improvement circuit stated with the gestalt of this operation, since the way becomes more efficient having made low level which carries out a pressure up, there is efficient effectiveness of a duplex.
[0135] Furthermore, since the applied voltage to need changes according to generating torque and an engine speed, according to the operational status of an inverter, efficient operation of a motor is attained from operation by the 1st fixed voltage level by changing the 1st voltage level.
[0136] As mentioned above, without suspending actuation of a power-factor-improvement circuit by forming the safeguard 17 which carries out protected operation which stops a switching device 5 temporarily with the 1st voltage level which is not the level which a switching device 5 damages, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and it becomes possible to offer a reliable power-factor-improvement circuit.
[0137] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.
[0138] Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value by setting up the 1st voltage level, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head. Moreover, it can prevent damaging [******] a switching device, with actuation of a switching device 5 suspended at the time more than the 2nd voltage level.
[0139] The gestalt of gestalt 9. book implementation of operation is drawing 9 in the gestalt 5 of operation, replaces the current level-setting machine 13 with an electrical-potential-difference level-setting machine, and considers it as the configuration which inputted the signal of the electrical-potential-difference detector 9 at a comparator 14. Drawing 17 is the block diagram of the protection network of the PWM control device in which the gestalt 9 of implementation of this invention is shown. In drawing, the sign same identically to drawing 15 of the gestalt 8 of operation as a considerable part is attached, and explanation is omitted. 18 is a control gain

regulator which adjusts the control gain of the PWM controller 11, when the 1st voltage level is exceeded. Moreover, with the gestalt of this operation, the breaker 51 of operation in drawing does not intercept actuation of a switching device 5, when the 1st voltage level is exceeded, and when the 2nd voltage level is exceeded, it serves to stop a switching device 5.

[0140] Next, the flow chart of drawing 18 explains the actuation in this operation gestalt. First, a switching device 5 is operated with the PWM controller 11 (S61). And the direct current voltage detected with the direct-current-voltage detector 9 is compared with the 1st voltage level by the comparator 14 (S62). When the direct current voltage detected rather than the 1st voltage level is small, a power-factor-improvement circuit operates without changing the control gain in the PWM controller 11. However, when the direct current voltage detected rather than the 1st voltage level is large, the control gain regulator 18 reduces the control gain of the PWM controller 11, and carries out PWM actuation of the switching device 5 (S63).

[0141] Next, the direct current voltage detected with the direct-current-voltage detector 9 is compared with the 2nd voltage level by the comparator 14 (S64). When the 2nd voltage level is exceeded, the breaker 51 of operation outputs a signal so that actuation of a switching device 5 may be suspended to a driver 12 (S65). The cutoff of operation at the time of exceeding the 2nd voltage level is canceled by the PWM controller 11 with the cutoff discharge vessel 16 only during a halt of a switching device 5 of operation (S66).

[0142] This is because the semantics stopped exceeding the 2nd voltage level is lost, when the actuating signal from the PWM controller 11 to a switching device 5 is outputted and cutoff actuation is canceled.

[0143] As mentioned above, since the control gain of the PWM controller 11 is reduced when the 1st voltage level is exceeded, the PWM signal which operates a switching device 5 decreases, therefore ON actuation of a switching device 5 is reduced, and direct current voltage falls.

[0144] Moreover, without also stabilizing a control system and suspending actuation of a power-factor-improvement circuit because the direct current voltage to output is stabilized and an electrical-potential-difference ripple falls since control gain falls, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and a reliable power-factor-improvement circuit can be offered.

[0145] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0146] Moreover, when a load 7 turns into a light load and a detection electrical-potential-difference value becomes small sharply from the 1st voltage level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.

[0147] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.

[0148] The gestalt of gestalt 10. book implementation of operation is drawing 12 in the gestalt 6 of operation, replaces the current level-setting machine 13 with an electrical-potential-difference level-setting machine, and considers it as the configuration which inputted the signal of the electrical-potential-difference detector 9 at a comparator 14. Drawing 19 is the protection network block diagram of the PWM control device in which the gestalt 10 of implementation of this invention is shown. In drawing, the sign same identically to drawing 17 of the gestalt 9 of operation as a considerable part is attached, and explanation is omitted. In drawing, 62 is an amendment machine which adds amendment to the command electrical potential difference of the PWM controller 11 by the comparator 14 when a detection electrical potential difference is larger than the 1st voltage level.

[0149] Next, the flow chart of drawing 20 explains the actuation in this operation gestalt. First, a switching device 5 is operated with the PWM controller 11 (S71). And the direct current voltage detected with the direct-current-voltage detector 9 is compared with the 1st voltage level by the comparator 14 (S72). When the direct current voltage detected rather than the 1st voltage level is small, a power-factor-improvement circuit operates without changing the control gain in the PWM controller 11. However, when the direct current voltage detected rather than the 1st voltage level is large, the amendment machine 20 applies correction value to the PWM controller 11, and carries out PWM actuation of the switching device 5 (S73).

[0150] Next, the direct current voltage detected with the direct-current-voltage detector 9 is compared with the 2nd voltage level by the comparator 14 (S74). When the 2nd voltage level is exceeded, the breaker 51 of operation outputs a signal so that actuation of a switching device 5 may be suspended to a driver 12 (S75).

Discharge of the cutoff of operation at the time of exceeding the 2nd voltage level is canceled by the PWM controller 11 with the cutoff discharge vessel 16 only during a halt of a switching device 5 of operation (S76).
[0151] This is because the semantics stopped exceeding the 2nd voltage level is lost, when the actuating signal from the PWM controller 11 to a switching device 5 is outputted and cutoff actuation is canceled.
[0152] Since it is controlling to become a direct-current bus-bar electrical potential difference on a target command electrical potential difference, the PWM controller 11 does not exceed the 1st voltage level, when the 1st voltage level is higher than a target command electrical-potential-difference value. However, since actual direct current voltage is over the 1st voltage level, it is going to reduce an actual direct-current-voltage value by applying correction value to the PWM controller 11, and reducing the command electrical-potential-difference value made into the target of the PWM controller 11.
[0153] Without the direct current voltage to output falling, therefore suspending actuation of a power-factor-improvement circuit, since the command electrical-potential-difference value of the PWM controller 11 falls as mentioned above, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and a reliable power-factor-improvement circuit can be offered.
[0154] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0155] Moreover, although amendment was added to the command electrical-potential-difference value with the amendment vessel 62, since a direct-current-voltage value falls even if it adds amendment to a command current value, even if it adds amendment to a command current value, it is satisfactory in any way.
[0156] Moreover, when a load 7 turns into a light load and a detection electrical-potential-difference value becomes small sharply from the 1st voltage level after applying correction value, even if it reduces the applied correction value and abolishes the amendment condition of a control system, it is satisfactory in any way.
[0157] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.
[0158] The gestalt of gestalt 11. book implementation of operation is drawing 6 in the gestalt 2 of operation, replaces the current level-setting machine 13 with an electrical-potential-difference level-setting machine, and considers it as the configuration which inputted the signal of the electrical-potential-difference detector 9 at a comparator 14. Drawing 21 is the block diagram of the protection network of the PWM control device in which the gestalt 11 of implementation of this invention is shown. In drawing, the sign same identically to drawing 15 of the gestalt 8 of operation as a considerable part is attached, and explanation is omitted. When the 1st voltage level is exceeded, the control gain regulator 63 in drawing does not adjust the control gain of the PWM controller 11, and the period decided beforehand and when the 1st voltage level is exceeded continuously, it adjusts the control gain of the PWM controller 11.
[0159] Next, the flow chart Fig. of drawing 22 explains actuation of a protection network 17. Actuation (S81-S84, S87) when direct current voltage reaches the 1st voltage level Actuation (S88-S90) when it is the same as that of the actuation (S51-S54, S55) shown in drawing 16 of the gestalt 8 of operation and an electrical-potential-difference value reaches the 2nd voltage level The point that are the same as that of the actuation (S56-S58) shown in drawing 16 of the gestalt 8 of operation, and the gestalt 1 of operation differs from actuation A period with the electrical potential difference which reaches the 1st voltage level, and when being detected continuously (S85), it is the point of reducing the control gain of the PWM controller 11 with the control gain regulator 63 (S86).
[0160] That the electrical-potential-difference value exceeding the 1st voltage level is detected continuously has the too large control gain of the PWM controller 11, and it is high. [of possibility that the excessive ripple has been in the electrical potential difference] It is this purpose to control the ripple of the electrical potential difference which the control gain of the PWM controller 11 is reduced and is produced by control there when the overvoltage which exceeds the 1st voltage level among the time amount of for example, about 25% of a power-source half period is detected continuously.
[0161] Moreover, although it is the control gain to reduce, about 5% of the present control gain is reduced. Although 3% or 10% are sufficient, if control gain is reduced rapidly here, it is temporary, but when the inverter to which it falls to rather than the direct-current-voltage value to need, for example, the motor is connected as a load is connected, the applied voltage to a motor is insufficient and there is a possibility that a motor may stop

reaching a need rotational frequency. Moreover, if the control gain to reduce is too small, effectiveness of a control gain fall cannot show up easily.
[0162] Here, generally control gain is used for the operation in S/W, and the fall of control gain can be realized by changing the gain factor on data processing.
[0163] As mentioned above, modification to the control gain according to a target electrical-potential-difference value is attained by adding the control gain regulator 63. Since the direct current voltage detected with the direct-current-voltage detector 9 since the ripple of direct current voltage can be reduced also stops also exceeding the 1st voltage level and it stops stopping actuation of a switching device 5 by the safeguard 17 Supply becomes possible from the technique explained with the gestalt 8 of implementation of invention to a load 7 about the direct current voltage which the control system was stabilized and was stabilized more.
[0164] Furthermore, since prohibition of actuation of the switching device 5 by the safeguard 17 is lost, by actuation of a safeguard 17, it becomes possible to bring the distorted input current close in the shape of a sine wave more, and contributes to much more power factor improvement.
[0165] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0166] Moreover, when a load 7 turns into a light load, consequently a detection electrical-potential-difference value becomes small sharply from the 1st voltage level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.
[0167] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.
[0168] Furthermore, although it takes into consideration applying the flow chart shown in drawing 22 to what was shown in the gestalt 8 of operation, as S84 was shown in the gestalt 10 of operation, when the 1st voltage level is exceeded, even if it is the configuration that correction value is applied to the PWM controller 11, it cannot be overemphasized that there is same effectiveness. In this case, since actuation (S88-S90) when an electrical-potential-difference value reaches the 2nd voltage level becomes being the same as that of the actuation (S74-S76) shown in drawing 20 of the gestalt 10 of operation, the point that this operation gestalt 11 differs from actuation is actuation when an electrical potential difference reaches the 1st voltage level (S82 and S87 are unnecessary).
[0169] Gestalt 12. drawing 23 of operation is the block diagram of the protection network of the PWM control device in which the gestalt 12 of implementation of this invention is shown. In drawing, the sign same identically to drawing 21 of the gestalt 11 of operation as a considerable part is attached, and explanation is omitted. The period decided beforehand and when the 1st voltage level is exceeded continuously, the amendment machine 64 in drawing is not a control gain regulator to which the control gain of the PWM controller 11 is reduced, and applies correction value to the PWM controller 11.
[0170] Actuation of the protection network 17 in the gestalt of this operation is almost the same as that of the gestalt 11 of operation, and a different point is a point of operating so that control gain in the gestalt 11 of operation may not be reduced and correction value may be applied, when the period and the 1st voltage level which were defined beforehand continuously are exceeded. With the gestalt of this operation, in the flow chart of drawing 22 , if S86 applies not a control gain fall but correction value, it will become. Thus, an PWM control unit is protected from an overvoltage, without stabilizing direct current voltage and suspending actuation of an PWM control unit.
[0171] As mentioned above, without the direct current voltage to output falling, therefore suspending actuation of a power-factor-improvement circuit, since the command electrical-potential-difference value of the PWM controller 11 falls by adding the amendment machine 64, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and a reliable power-factor-improvement circuit can be offered.
[0172] Furthermore, since prohibition of actuation of the switching device 5 by the safeguard 17 is reduced, by actuation of a safeguard 17, it becomes possible to bring the distorted input current close in the shape of a sine wave more, and contributes to much more power factor improvement.
[0173] Moreover, although amendment was added to the command electrical-potential-difference value with the amendment vessel 64, since a direct-current-voltage value falls even if it adds amendment to a command current value, even if it adds amendment to a command current value, it is satisfactory in any way.

[0174] Moreover, when a load 7 turns into a light load and a detection electrical-potential-difference value becomes small sharply from the 1st voltage level after applying correction value, even if it reduces the applied correction value and abolishes the amendment condition of a control system, it is satisfactory in any way.
[0175] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.
[0176] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0177] The gestalt 13 of gestalt 13. implementation of operation shows the concrete method of changing gain, when the PWM controller 11 in the gestalt 9 of operation is equipped with the PI control section.
[0178] The configuration of a protection network 17 is the same as drawing 1717 of the gestalt 9 of operation, and drawing 24 is the control-block Fig. showing the PI control section of the PWM controller 11. In drawing, in order to control the PI control and input current of an electrical potential difference for controlling direct current voltage, it consists of two control block of PI control.
[0179] First, control of the power-factor-improvement circuit at the time of using PI control is explained. The direct-current-voltage value detected with the direct-current-voltage detector 9 in drawing 15 , the input current value detected with the input current detector 8 and the phase detected with the phase detector 10, and a sin curve in phase are used for drawing 24 .
[0180] Although it is the PI control of the electrical potential difference in drawing 24 , the value which carried out the multiplication of the difference which the difference of the direct-current-voltage command value and direct-current-voltage detection value which are first made into the target stored in the PWM controller 11 was computed, and was computed to the proportional gain Kv1 of an electrical potential difference serves as a proportional. Moreover, the multiplication of the computed difference is carried out to the integral gain value Kv2 of an electrical potential difference, and the value adding the value and aggregate value of the multiplication value to last time serves as an integral term. The value adding this proportional and an integral term is a control output value of PI control, and, generally it is known that controlling by the above control output values is PI control.
[0181] Here, it multiplies by the output value in the PI control of an electrical potential difference with sintheta with a multiplier. The output of this multiplier serves as a command value of a target current. This sin curve turns into an electrical-potential-difference phase and a sin curve in phase with the phase detector 10 which detects the electrical-potential-difference phase of AC power supply 1.
[0182] The current command value outputted with this multiplier and the input current detection value detected with the input current detector 8 are used by the PI control of a current. Like [the PI control of a current] the PI control of an electrical potential difference, a proportionality component and an integral component are computed and the PWM output value which carries out PWM control of the switching device 5 is acquired from those sums as shown in drawing 24 from the difference of a current command value and a current detection value. This PWM output value is inputted into the driver 12 in drawing 17 , and operates a switching device 5.
[0183] Although actuation here is the same as that of the flow chart of drawing 18 and it is the approach of reducing the control gain of the PWM controller 11 (S63), control gain is reduced about 5% as above-mentioned. Here, the control gain value shown in drawing 24 reduces Kv1, Kv2, Ki1, Ki2, those with four piece, and at least one or more gain values.
[0184] Namely, in a certain case, two or more control gain values with possible making it fall reduce either or both.
[0185] Moreover, although the control gain to reduce has the gain value of the PI control of an electrical potential difference, and the PI control of a current as it is shown in drawing 24 , it may reduce the control gain value of either or both.
[0186] Moreover, although at least P gain or I gain either may be reduced, it is early that the effectiveness of a gain fall of the way where the way of P gain lowers P gain since immediate effect nature is high shows up.
[0187] Furthermore, although it applied to the gestalt 9 of operation and the gestalt 13 of this operation explained, if it is the gestalt of operation containing a control gain regulator, even if it applies to the gestalt of which operation, it cannot be overemphasized that there is same effectiveness.
[0188] As mentioned above, modification to the control gain according to a target electrical-potential-difference

value is attained by adjusting control gain. Since the direct current voltage detected with the direct-current-voltage detector 9 since the ripple of direct current voltage can be reduced also stops also exceeding the 1st voltage level and it stops stopping actuation of a switching device 5 by the safeguard 17 Supply becomes possible from the technique explained with the gestalt 8 of implementation of invention to a load 7 about the direct current voltage which the control system was stabilized and was stabilized more.
[0189] Furthermore, since prohibition of actuation of the switching device 5 by the safeguard 17 is lost, by actuation of a safeguard 17, it becomes possible to bring the distorted input current close in the shape of a sine wave more, and contributes to much more power factor improvement.
[0190] Moreover, when a load 7 turns into a light load, consequently a detection electrical-potential-difference value becomes small sharply from the 1st voltage level after reducing control gain, even if it raises control gain and brings the responsibility of a control system forward, it is satisfactory in any way.
[0191] Furthermore, even if it changes the 1st voltage level according to the burden connected, it is satisfactory in any way.
[0192] Furthermore, the control-block Fig. in the case of applying correction value to the PWM controller 11 which consists of PI control shown in drawing 24 is shown in drawing 25 . Although the configuration which adds amendment to the command value of an electrical potential difference is taken in drawing 25 , even if it makes it a configuration which applies correction value to the command value of a current, it cannot be overemphasized that there is same effectiveness.
[0193] Gestalt 14. drawing 26 of operation and drawing 27 are the block diagrams of the power circuit of the PWM control device in which the operation gestalt 14 of this invention is shown, and its protection network. In drawing, the sign same identically to drawing 17 of the gestalt 9 of operation as a considerable part is attached, and explanation is omitted. The burden controller 65 in drawing outputs a signal which increases a burden to the load which the PWM control unit has connected, when the 1st voltage level is exceeded.
[0194] Next, the situation of the direct current voltage of an PWM control device, the charge to the smoothing capacitor 4 currently used for the PWM control device, and discharge is explained. If the PWM control unit is operating, the power to need will be supplied to the load 7 connected to the PWM control unit from a smoothing capacitor 4. Since the PWM control device is carrying out pressure-up actuation, it is because it cannot charge from AC power supply 1 to a smoothing capacitor 4.
[0195] As the Prior art also described, in other words, charge to a smoothing capacitor 4 is performed by the direct current voltage which carries out a pressure up, and the energy stored in the reactor 3. Therefore, an PWM control unit will be stabilized in the direct current voltage from which the power stored in a smoothing capacitor 4 and the power consumed by the load 7 will be in equilibrium.
[0196] Control of the direct current voltage of an PWM control unit is controlling direct current voltage to any value by controlling the amount of energy stored in a reactor 3. Here, when the burden of the load 7 of an PWM control unit decreases rapidly, the amount of energy does not come about the response of a control system, but the power of the charge and discharge of a smoothing capacitor 4 will be in an unbalance condition. Therefore, although direct current voltage will turn into a high voltage, without the ability controlling to any value, in time amount progress, the amount of energy will be in equilibrium, and an PWM control unit will be in a stable state.

[0197] However, in case it becomes a high voltage, when direct current voltage rises even on the level more than pressure-proofing of a switching device 5 or a smoothing capacitor 4, it is necessary to protect an PWM control unit. In this case, it must not stop but whether suspending the energy supply to a smoothing capacitor 4 from a reactor 3 emitting energy from an PWM control device by suspending actuation of a switching device 5 and suspending supply of the energy to a reactor 3, since it is impossible unless circuitry's is changed, and actuation of a switching device 5 must be avoided from an overvoltage by one approach of whether the energy of a smoothing capacitor 4 will be emitted beyond the need.
[0198] The approach of lessening a halt of a switching device 5 of operation infinite, and avoiding from an overvoltage is as the gestalt of operation to the above-mentioned having described, and can be realized. With the gestalt of this operation, energy is emitted from a smoothing capacitor 4 beyond the need, and how to reduce direct current voltage is stated by discharging the both-ends electrical potential difference of a smoothing capacitor 4.
[0199] Actuation of drawing 26 is explained. A comparator 14 compares the direct-current-voltage value

detected with the direct-current-voltage detector 9, and the 1st voltage level set up with the electrical-potential-difference level-setting vessel 61. When the direct-current-voltage value detected from the 1st voltage level is higher, it outputs so that a burden may be increased to a load 7 with the burden controller 65.

[0200] In order to emit energy from a smoothing capacitor 4, there is no approach besides consuming by the load 7. Then, when a direct-current-voltage value is higher than a target value, by increasing a burden, the charge currently stored in the smoothing capacitor 4 is emitted, direct current voltage is discharged, a direct-current-voltage value is reduced, and an PWM control unit is protected.

[0201] Moreover, since actuation of a switching device 5 has not stopped direct current voltage when the burden of a load 7 is increased and it is going to protect a circuit from an overvoltage, after exceeding the 1st voltage level, but direct current voltage does not fall, even if it makes a burden increase and energy is continuing being supplied to a reactor 3, the 2nd voltage level is exceeded someday.

[0202] When the 2nd voltage level is exceeded, a signal is outputted from a comparator 14 and a driver 12 stops a switching device 5 by the signal of the breaker 51 of operation. After the actuating signal of a switching device 5 stops from the PWM controller 11, the signal which cancels cutoff of operation of the cutoff discharge machine 16 is outputted.

[0203] This the actuation of a series of is the same as actuation of S14-S16 of the flow chart of drawing 18 of the gestalt 9 of operation.

[0204] Moreover, the burden of a load 7 is increased, and although it is the realistic approach of discharging from a smoothing capacitor 4, it is realizable if the inverter which drives a motor load is a controllable load about a burden electronically as a load 7.

[0205] Drawing 27 is a block diagram in case the inverter 25 accompanied by a motor load 23 is connected as a load 7. The inverter controller 21 of an inverter 25 receives the output signal of the burden controller 65, and it operates so that the motor load 23 connected to the inverter 25 may be made to increase.

[0206] Although it is the increment approach of the burden in the inverter controller 21, when DC brushless motor of a three phase circuit is connected as a motor load 23, the inverter controller 21 is controlling the electrical potential difference and frequency for a three phase circuit which are impressed to the coil of a motor load 23, for example in order to operate a motor load 23. Furthermore, as for an inverter, the electrical potential difference made to impress to a motor load 23 is also controlling those with a three-phase-circuit part, and the energization phase for every phase.

[0207] Although the inverter controller 21 is controlling the include angle of this energization phase to switch, a burden increases a motor load 23 by delaying this energization phase angle. Since this will output fixed power if an energization phase angle is delayed, it is for the effectiveness of a motor to fall and the load of a motor load 23 is fixed, if effectiveness falls, the input power of a motor load 23 will increase it. In other words, the output power of an inverter 25 increases.

[0208] Since the output power of an inverter 25 increases, when it means that the burden of an PWM control unit had increased and the burden increased, direct current voltage discharges and it becomes possible to protect an PWM control unit from an overvoltage.

[0209] Without discharging direct current voltage and suspending actuation of an PWM control unit by making the burden of the load linked to an PWM control unit increase, when the direct current voltage which detected the 1st voltage level as mentioned above exceeds, it becomes possible to protect an PWM control unit from an overvoltage, and a reliable PWM control unit can be offered.

[0210] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0211] Moreover, since the amount of energy of an PWM control device becomes controllable in the amount of inputs according to the amount of outputs even if it returns to the burden before reaching the 1st voltage level in the burden of the load linked to an PWM control device and increasing a burden, after discharging direct current voltage, even if it returns a burden to the original condition, it cannot be overemphasized that it is satisfactory.

[0212] Furthermore, when the inverter which is carrying out electronics control is a load 7 and the signal of the increment in a burden disappears from the burden regulator 65 for example, since an auto return is carried out to the loaded condition which should be controlled essentially, the inverter controller 21 does not need to send the signal for returning from an PWM control unit.

[0213] Furthermore, although the burden was made to increase by delaying an energization phase angle in the case of the inverter load stated to the gestalt of this operation, even if it increases the rotational frequency of a motor load, it makes a burden increase and it discharges, it cannot be overemphasized that there is same effectiveness.
[0214] Furthermore, although the burden was made to increase by delaying an energization phase angle in the case of the inverter load stated to the gestalt of this operation, even if increase the applied voltage to a motor load, it makes a burden increase and it discharges, it cannot be overemphasized that there is same effectiveness.
[0215] Gestalt 15. drawing 28 of operation is the block diagram of the power circuit of the PWM control device in which the operation gestalt 15 of this invention is shown, and its protection network. In drawing, the sign same identically to drawing 27 of the gestalt 14 of operation as a considerable part is attached, and explanation is omitted. In drawing, 15 is a breaker of operation which makes actuation of a switching device 5 intercept by the result in a comparator 14, and this is the same as that of drawing 15 of the gestalt 8 of operation.
[0216] Next, the actuation in drawing 28 is explained. It is the same as that of the gestalt 14 of operation to compare the 1st voltage level with the detected direct-current-voltage value. When the detected direct-current-voltage value exceeds the 1st voltage level, the burden controller 65 outputs a signal so that the burden in the inverter 25 connected as a load may be made to increase. To it and coincidence, the breaker 15 of operation intercepts actuation of the switching device 5 in the carrier. Moreover, when the detected direct-current-voltage value exceeds the 2nd voltage level, it is made to stop so that a switching device 5 may not be operated. These are the same actuation as the gestalt 8 of operation.
[0217] As mentioned above, it becomes much more possible by discharging direct current voltage to reduce direct current voltage, intercepting actuation of a switching device 5. Consequently, since evasion becomes possible from an overvoltage quickly rather than the method which could protect the PWM control unit from the overvoltage, and was stated with the gestalt 8 of operation, without suspending actuation of an PWM control unit, a much more reliable PWM control unit can be offered.
[0218] Furthermore, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0219] Moreover, even if it carries out combining the discharge approach stated with the gestalt 14 of the protection approach stated with the gestalten 9-13 of operation, and operation, it cannot be overemphasized that there is the same effectiveness as the gestalt 15 of this operation.
[0220] The gestalt of gestalt 16. book implementation of operation is considered as the configuration whose overcurrent cannot generate easily the reactor 3 shown in drawing 1 in the gestalt 1 of operation, and changes the function of current level-setting machine 13 grade. The block diagram of the protection network of the PWM control device which drawing 29 shows the gestalt 16 of implementation of this invention, drawing in which in drawing 30 R> 0 the wave form chart of input voltage and a current and drawing 31 show the perspective view of a reactor, and drawing 32 shows the combination of drawing 31 , and 33 are the frame-like core top views of a reactor. In drawing 29 , the sign same identically to drawing 1 of the gestalt 1 of operation as a considerable part is attached, and explanation is omitted. The current level-setting machine which sets up current level with 66 fixed, and 67 are protection networks which protect the switching device 5 of the power circuit which is carrying out PWM control.
[0221] For a transversal frame core and 72, in drawing 31 and 32, a door-post core and 71a of thin core material and 73 are [71 / a gap and 74] coils. As shown in drawing, by combining respectively the transversal frame core 71 of a rectangular parallelepiped, and two door-post cores 72 at a time, the frame-like core 75 of a reactor is formed and a gap 72 is formed in four connection parts of the transversal frame core 71 and the door-post core 72. This connection inserts the sheet (not shown) of the non-magnetic material of fixed thickness in a connection, for example, and forms a gap 72, and immobilization of a connection is the stationary plate (not shown) of the shape of a typeface of KO, and fixes the connection of the transversal frame core 71 and the door-post core 72 in total in ******.
[0222] Next, actuation is explained. By setting in a power-factor-improvement circuit, and turning off and turning off a switching device 5 first, the energy stored in a reactor 3 changes, the electrical potential difference according to the amount of energy currently stored in the reactor 3 occurs to the both ends of a reactor 3, and the aggregate value of the electrical potential difference of AC power supply 1 and the both-ends electrical

potential difference of a reactor 3 is charged by the smoothing capacitor 4. And by changing the amplitude value of the sine wave of an input current, the PWM controller 11 makes an input current the shape of a sine wave, and it carries out PWM control of the switching device 5 so that direct current voltage may be controlled to any value.
[0223] The reactor 3 has the duty which contributes to a pressure up and carries out smooth [of the current], and the more current capacity becomes large, the more it becomes what has a small inductance value. And a reactor 3 will become easy to be saturated if an inductance value becomes small. When a reactor 3 is saturated, it stops functioning as a reactor 3, and will become a load equivalent to resistance.
[0224] Since it is the same as the condition of carrying out the power-source short circuit with the reactor 3 which turned into resistance when this reactor 3 is saturated, and a switching device 5 is turned on, a steep and big current as shown in drawing 30 (b) flows a circuit top to the input voltage shown in drawing 30 (a). And if a reactor 3 escapes from a saturation state, it will return to normal operation and unchanging actuation.
[0225] Although the protection network 67 protected the switching device 5 from this overcurrent, it set up the 1st and 2nd current level in the current setter 13 of the protection network 17 of the gestalt 1 of operation. The 2nd current level sets up the maximum current value which a switching device 5 does not damage, and protects it from a switching device 5 being damaged. And when it was lower than the 2nd current level, a large value is somewhat set up rather than the maximum rating current value of a load, the whole circuit will be temporarily protected from an excessive current before reaching the level which a switching device 5 damages, and a reactor 3 will be [and] in a saturation state, the 1st current level prevents a switching device 5 turning on, and it sets it up so that actuation of a power-factor-improvement circuit may not be stopped.
[0226] As mentioned above, a reactor is saturated, a sudden overcurrent flows in a power-factor-improvement circuit, when the maximum current value (2nd current level of the gestalt 1 of operation) which a switching device 5 does not damage is exceeded, actuation of a switching device 5 will stop and direct current voltage will fall. So, with the gestalt of this operation, it is made for the sudden overcurrent by the saturation of a reactor 3 not to occur as a configuration as shown in drawing 31 , and an overcurrent is prevented. Therefore, in the protection network 67 of the gestalt of this operation, the current level-setting machine 66 did not set up the 1st current level of the gestalt 1 of operation, but set up the maximum current value which the switching device 5 equivalent to the 2nd current level does not damage as fixed current level.
[0227] Although the total amount of gaps of each prepared gap 73 is large, the direct-current superposition property of a reactor 3 improves and a sudden overcurrent is controlled by the configuration of the reactor shown in drawing 31 Although the number of the connection parts of the frame-like core 75 of a reactor 3 is four, the frame-like core 75 all amount of gaps of a reactor turns into a total amount of the amount of gaps per piece of a gap 73, and the number of a gap 73, and the amount of gaps per piece is so small that there are many gaps 73, and it ends. If the amount of gaps is small, the error of the amount of gaps will also become small and can make dispersion in the engine performance of a reactor small.
[0228] However, in a reactor which combines two cores 76 of U typeface as shown in drawing 48 of the conventional example, since a gap 73 is two places, to the reactor of the gestalt of this operation, the amount of gaps per piece doubles and dispersion in the amount of gaps becomes large.
[0229] In addition, although accumulate thin core material 71a, it laminates, it constitutes and the transversal frame core 71 and the door-post core 72 constitute the frame-like core 75 of a reactor by combining two pieces at a time respectively, the transversal frame core 71 and the door-post core 72 are the combination of the direction which carried out the laminating, and make the connection side the field which can be seen in drawing 31 and drawing 3232 . However, the configuration which shows the field of the thin core material of one sheet in drawing 34 which serves as a connection side may be used. However, in the case of combination as shown in drawing 34 , since magnetic reluctance becomes large, the approach of put together as shown in drawing 31 and drawing 3232 is desirable.
[0230] Moreover, the eddy current generated with the transversal frame core 71 and the door-post core 72 is controlled by laminating thin core material 71a. Since this eddy current is generated inside thin core material 71a, the more core material 71a is thin, the more the yield of an eddy current decreases. Then, if it is the core material of board thickness thinner than the core material of 0.2mm board thickness, since generating of an eddy current will decrease very much and loss with the reactor by the eddy current will decrease, generation of heat with a reactor can be controlled. When the performance degradation of the reactor by generation of heat

decreases, it becomes possible to prevent a sudden overcurrent. In order for the high frequency current to flow especially in the case of the application of a power-factor-improvement circuit, it is easy to generate an eddy current and it necessary to control in thin core material 71a.
[0231] Furthermore, since there is an inclination for loss to become large from the thing of a low frequency application, for the eddy current by the high frequency current, it is necessary to suppress loss as much as possible and to control generation of heat with the transversal frame core 71 of the reactor of a power-factor-improvement circuit application, and the door-post core 72. Therefore, it is necessary using core material 71a with high permeability to constitute the magnetic circuit which can disregard the field in the inside of the transversal frame core 71 and the door-post core 72.
[0232] Moreover, when the magnetic substance with the property of directivity in which the magnetic reluctance in magnetic-flux passage changes with the directions through which magnetic flux passes as thin core material is used, as shown in drawing 32 in consideration of the sense to which magnetic flux flows, the transversal frame core 71 and the door-post core 72 are arranged, and a reactor is constituted. According to an one direction, the laminating of the sense of the directivity of thin core material 71a is carried out, and the transversal frame core 71 and the door-post core 72 are constituted so that it may be easy to flow in the direction of a long side of the transversal frame core 71 and the door-post core 72 and may become to it. Thus, when the transversal frame core 71 and the door-post core 72 which were constituted are combined, the direction where magnetic flux tends to flow is arranged so that it may go around.
[0233] Even if it uses the core material of a property without directivity as thin core material 71a here, it cannot be overemphasized that it is satisfactory.
[0234] Furthermore in drawing 33 , the transversal frame core 71 and the door-post core 72 have combined the thing of the same dimension a, and the coil 74 is given to the long side for them in the union cotton reactor. Although it cannot be overemphasized that it is satisfactory even if the configuration of the transversal frame core 71 and the door-post core 72 is not the same dimension, as for 2 sets of cores which serve as the opposite side when binding tight and processing it, it is desirable to become the same dimension. Furthermore, when manufacturing the transversal frame core 71 and the door-post core 72, it is easy to mass-produce the direction used as the same dimension.
[0235] The iron core to be used is used effectively, and it is smaller than the conventional thing, and can consider as high performance and low loss, and engine-performance dispersion of a reactor also becomes small, and the reactor constituted as mentioned above has more high reliability, and can be protected from a sudden overcurrent. Therefore, even if it does not set up the 1st current level for performing cutoff of a temporary switching device 5 of operation, the shutdown of the PWM control unit by the overcurrent can be avoided, and the dependability of an PWM control unit can also improve. Furthermore, for the structure which does not insert a gap in the interior of a coil, dispersion in the gap at the time of assembly can be inspected visually, and dispersion can be lessened.
[0236] In addition, the current detector which flows to PWM with the gestalt of this operation and which carries out current detection, The comparator which compares the current level-setting machine set as fixed current level with the fixed current level set up with this current level-setting vessel and the current value detected by said current detector, Although the thing equipped with the breaker of operation which maintains a halt of said switching device of said PWM controller of operation was shown when said detected current value was said more than fixed current level, it replaces with a current and is good also as an electrical potential difference.
[0237] Gestalt 17. drawing 35 of operation is the plan of the frame-like core 75 of the reactor in which the gestalt 2 of operation of this invention is shown. When thickness of the rectangular direction of the plane of composition of a and a transversal frame core was set to b for the die length of a transversal frame core, the die length of a door-post core is made into a-2b, and it sees from the upper part, and was made for a reactor to serve as a square by drawing 35 here, although the dimension of the transversal frame core 71 and the door-post core 72 was the same in drawing 33 of the gestalt 16 of operation.
[0238] When it constitutes like drawing 35 , in order to have the thing and identity ability which are shown in drawing 33 , it is necessary to enlarge the part and thickness to which the dimension of the door-post core 72 became small. Therefore, when it becomes the thin reactor of a slim configuration when constituted like drawing 33 , and constituted like drawing 35 , it becomes closer to a cube than the reactor constituted like drawing 31 .

[0239] Although it becomes equivalence efficiently whichever it makes it, the direction may become small having constituted like drawing 35 in capacity. Since it changes with the specifications of a reactor, by making it the configuration according to a specification, a more highly efficient reactor can be miniaturized further and a sudden overcurrent can be controlled with a cheap reactor.
[0240] As mentioned above, a reactor can be miniaturized, a sudden overcurrent can be controlled with a cheap reactor, even if it does not set up the 1st current level for performing cutoff of a temporary switching device 5 of operation, the shutdown of the PWM control unit by the overcurrent can be avoided, and the dependability of an PWM control unit can also improve.
[0241] The plan showing the series winding of the reactor which drawing 36 shows the gestalt 3 of operation about how to coil a coil with the gestalt of gestalt 18. book implementation of operation, the plan in which drawing 37 shows the parallel winding of a reactor, and drawing 38 are the circuit diagrams showing the coil approach of a reactor. A coil gives a coil to each of the door-post core 72 which is the opposite side of the frame-like core 75. This is for using effectively the transversal frame core 71 and the door-post core 72, and is because it becomes impossible to give a coil in the lap part of a coil when a coil 74 is given with the adjacent transversal frame core 71 and the adjacent door-post core 72.
[0242] Drawing 36 is drawing having shown signs that the coil was coiled around the serial to the door-post core 72. Moreover, drawing 37 coils a coil around juxtaposition. Here, a serial or juxtaposition is [which connects a reactor in serial by having the reactor made by giving a coil 74 to the door-post core 72 to the opposite side] or or whether to connect in juxtaposition in how to coil a coil. The situation is shown in drawing 38 .
[0243] When it winds around a serial like drawing 36 , in order that the number of turns per core may end in one half as compared with a multiple winding, the generating magnetic flux in the door-post core 72 which gave the coil 74 ends in one half as compared with a multiple winding. Since the magnetic flux generated to the frame-like core 75 is proportional to number of turns theoretically, per [to which the coil 74 was given] core, rather than a multiple winding, generating magnetic flux can be managed with one half, and a leeway is given to the magnetic saturation in the transversal frame core 71 and the door-post core 72.
[0244] Next, although it is a multiple winding, by making it a multiple winding, the amount of currents which flows to a coil becomes half, and the copper loss depending on a resisted part of a coil can be reduced. Here, copper loss W determines by W=I2 R that the amount of currents which flows to a coil will set I and a resisted part in a coil to R. Therefore, since the amount of currents becomes half, the loss by the multiple winding can be theoretically reduced to 1/4 rather than a series winding.
[0245] Here, since the high frequency current flows to the reactor of a power-factor-improvement circuit application, in a coil 74, the skin effect will occur and a current will flow only on the front face of a coil 74. Therefore, it is common to roll some by making a thin electric wire into three-fold [a duplex and], for example rather than to to use the thick electric wire set by current capacity, when a wire is used as a coil. Moreover, not a wire but the electric wire with which an electric wire is called a flat straight angle line may be coiled.
[0246] For example, in order in the case of the power-factor-improvement circuit application currently used for the air conditioner to make loss with a reactor small as much as possible and to realize in low cost, it is made a multiple winding in a wire.
[0247] As mentioned above, by doubling with the specification of a reactor and changing how coiling a coil, it becomes possible further by low loss to obtain a highly efficient reactor, and an PWM control unit can be protected from a sudden overcurrent.
[0248] Gestalt 19. drawing 39 of operation is the decomposition perspective view of the frame-like core of the reactor in which the gestalt 4 of operation is shown, and the plan of the frame-like core of a reactor. Although the connection side of the transversal frame core 71 and the door-post core 72 was perpendicularly connected with the gestalt 16 of operation, as shown in drawing 39 , the connection side of the transversal frame core 71 and the door-post core 72 is cut aslant, and it connects.
[0249] Thus, the connection side of the transversal frame core 71 and the door-post core 72 is cut aslant, by combining the transversal frame core 71 and the door-post core 72, magnetic flux is made easy to pass and magnetic reluctance is reduced. In this case, since it goes into the connection side between the transversal frame core 71 and the door-post core 72 as a gap 73 is shown in drawing 40 , a gap 73 also becomes slanting.
[0250] It cannot be overemphasized that it is satisfactory in any way even if it applies the technique which

makes the same dimension what sees the frame-like core 75 of a reactor as shown in the gestalt 17 of operation from the upper part, and makes it a square, and that of the transversal frame core 71 and the door-post core 72 to the gestalt of this operation, and there is same effectiveness.
[0251] Moreover, it cannot be overemphasized that it is satisfactory in any way even if it applies the series winding and multiple winding of the coil 74 as shown in the gestalt 18 of operation to the gestalt of this operation, and there is same effectiveness.
[0252] The transversal frame core 71 of a reactor and the door-post core 72 are cut aslant as mentioned above, magnetic reluctance can be reduced by combining them, a still low loss reactor can be obtained, the conversion efficiency of an PWM control unit becomes high, and an input current can be reduced if it is the same burden. Therefore, the sudden overcurrent by the saturation of a reactor stops being able to happen easily, and a reliable PWM control unit can be protected.
[0253]
[Effect of the Invention] Since this invention is constituted as explained above, it does effectiveness as taken below so.
[0254] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares the fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level Since it had the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every [when starting each period of said carrier] Without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overcurrent, and a reliable power-factor-improvement circuit can be offered.
[0255] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd current level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled. Said breaker of operation Since the output of said comparator forbids cutoff discharge of said cutoff discharge machine when said detected current value is said more than 2nd input current level Usually, without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overcurrent, even if a still bigger overcurrent occurs, a power-factor-improvement circuit can be protected, and a reliable power-factor-improvement circuit can be offered.
[0256] Furthermore, since it has the control gain regulator with which the cutoff signal which stops actuation of a switching device in a breaker of operation at the time more than fixed current level outputs the period defined beforehand and the signal which is outputted continuously and lowers the control gain of an PWM controller at the time of slack to said PWM controller and the count of a switching device of cutoff reduces, the direct current voltage by which a control system was stabilized more and stabilized more can supply to a load. Furthermore, by actuation of a protection network, the distorted input current can be close brought more in the shape of a sine wave, and a power-factor can be improved further.
[0257] In a breaker of operation above the 1st current level moreover, at the time under of said 2nd current level It is outputted continuously. the period which the cutoff signal which stops actuation of said switching device defined beforehand -- at the time of slack Since it has the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller and the count of cutoff of a switching device is reduced, the direct current voltage by which the control system was stabilized more and stabilized more can be supplied to a load. Furthermore, by actuation of a protection network, the distorted input current can be close brought more in the shape of a sine wave, and a power-factor can be improved further.
[0258] In the protection network of the PWM control unit which has one switching device which operates based

on the actuating signal from an PWM controller further again The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares the set point of this current level-setting machine with the current value detected by said current detector, and said detected current value are said more than fixed current level Since it had the control gain regulator which lowers the control gain of an PWM controller, a control system is stabilized and can supply the stable direct current voltage to a load. Furthermore, without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overcurrent, and a reliable power-factor-improvement circuit can be offered.

[0259] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator Since it had the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted, a control system is stabilized and the stable direct current voltage can be supplied to a load. Furthermore, without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overcurrent, and a reliable power-factor-improvement circuit can be offered.

[0260] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, In the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit Since it had the control gain regulator which lowers PWM control gain when said detected current value was more than fixed [said], the control gain according to a burden and the flowing instantaneous-carrying-current value can be set up, by it, a control system can be made stability and a power-factor can be raised further. Furthermore, the peak current can be suppressed, an overcurrent can be prevented, without suspending actuation of a power-factor-improvement circuit, and a reliable power-factor-improvement circuit can be offered.

[0261] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, In the period when it was beforehand set near the peak of the sine wave of the supply voltage of said PWM control unit said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd current level, and said comparator Since it had the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled, the control gain according to a burden and the flowing instantaneous-carrying-current value can be set up, by it, a control system can be made stability and a power-factor can be raised further. Furthermore, the peak current can be suppressed, an overcurrent can be prevented, without suspending actuation of a power-factor-improvement circuit, and a reliable power-factor-improvement circuit can be offered.

[0262] An PWM controller is equipped with the PI control section which carries out PWM control of the switching device, and a control gain regulator can output the signal to which either [at least] P gain of the PI control section or I gain is reduced, the processing load of a control system can be reduced, and S/W becomes small and can reduce cost more further again.

[0263] An PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device,

and since the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced is outputted, the processing load of a control system can be reduced, and S/W becomes small and, as for a control gain regulator, can reduce cost more.
[0264] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current detector which detects the current which flows to said PWM control device, and the current level-setting machine set as fixed current level, When the comparator which compares said fixed current level set up with this current level-setting vessel with the current value detected by said current detector, and said detected current value are said more than fixed current level Without suspending actuation of a power-factor-improvement circuit, since it had the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller might be lowered, a power-factor-improvement circuit can be protected from an overcurrent, and a reliable power-factor-improvement circuit can be offered.
[0265] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The current level-setting machine set to the current detector which detects the current which flows to said PWM control device, and the 1st current level and the 2nd current level, The comparator which compares said 1st [the] set up with this current level-setting vessel, and the 2nd current level and the current value detected by said current detector, and said detected current value above said 1st current level When said detected current value is said more than 2nd input current level, the output of the amendment machine which applies correction value so that the command current value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd current level, and said comparator Since it had the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted Usually, without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overcurrent, even if a still bigger overcurrent occurs, a power-factor-improvement circuit can be protected, and a reliable power-factor-improvement circuit can be offered.
[0266] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level Since it had the breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled every [when starting each period of said carrier] Without suspending actuation of a power-factor-improvement circuit, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and it becomes possible to offer a reliable power-factor-improvement circuit. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0267] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level The breaker of operation made to suspend actuation of said switching device within 1 period of the carrier of said PWM controller at the time under of said 2nd voltage level, When starting each period of said carrier, every, it has the cutoff discharge machine of which cutoff of said breaker of operation is canceled. Said breaker of operation Since the output of said comparator forbids cutoff discharge of said cutoff discharge machine when said detected electrical-potential-difference value is said more than 2nd input voltage level Usually, without suspending actuation of a

power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overvoltage, even if a still bigger overcurrent occurs, a power-factor-improvement circuit can be protected, and it becomes possible to offer a reliable power-factor-improvement circuit. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0268] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the set point of this electrical-potential-difference level-setting machine with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level Since it had the control gain regulator which lowers the control gain of an PWM controller Without suspending actuation of a power-factor-improvement circuit, since the direct current voltage to output is stabilized, an electrical-potential-difference ripple falls and a control system is stabilized, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and a reliable power-factor-improvement circuit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0269] Furthermore, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd voltage level, the output of the control gain regulator which lowers the control gain of an PWM controller at the time under of said 2nd voltage level, and said comparator Since it had the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted Without suspending actuation of a power-factor-improvement circuit, since the direct current voltage to output is stabilized, an electrical-potential-difference ripple falls and a control system is stabilized, it becomes possible to protect a power-factor-improvement circuit from an overvoltage, and a reliable power-factor-improvement circuit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0270] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference detector which detects the electrical potential difference which flows to said PWM control device, and the electrical-potential-difference level-setting machine which sets up a fixed voltage level, With the comparator which compares said fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level Without suspending actuation of a power-factor-improvement circuit, since it had the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller might be lowered, a power-factor-improvement circuit can be protected from an overvoltage, and a reliable power-factor-improvement circuit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0271] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference which

flows to said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level When said detected electrical-potential-difference value is said more than 2nd input voltage level, the output of the amendment machine which applies correction value so that the command electrical-potential-difference value or command electrical-potential-difference value of an PWM controller may be lowered at the time under of said 2nd voltage level, and said comparator Since it had the breaker of operation made to suspend actuation of a switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled when the actuating signal from said PWM controller is not outputted Usually, without suspending actuation of a power-factor-improvement circuit, a power-factor-improvement circuit can be protected from an overvoltage, even if a still bigger overvoltage occurs, a power-factor-improvement circuit can be protected, and a reliable power-factor-improvement circuit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0272] At moreover, when [the period when the cutoff signal which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level was defined beforehand, and when it is outputted continuously] Since it has the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller and the count of cutoff of a switching device is reduced Modification to the control gain according to a target electrical-potential-difference value is attained, and since the ripple of direct current voltage falls and a control system is stabilized more, supply of the direct current voltage stabilized more is attained. This is enabled to bring the distorted input current close in the shape of a sine wave more, and a power-factor can be improved more. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0273] In a breaker of operation above the 1st voltage level furthermore, at the time under of the 2nd voltage level The period when the cutoff signal which stops actuation of said switching device was defined beforehand, and when it is outputted continuously Since it has the control gain regulator which outputs the signal which lowers the control gain of an PWM controller to said PWM controller and the count of cutoff of a switching device is reduced Modification to the control gain according to a target electrical-potential-difference value is attained, and since the ripple of direct current voltage falls and a control system is stabilized more, supply of the direct current voltage stabilized more is attained. This is enabled to bring the distorted input current close in the shape of a sine wave more, and a power-factor can be improved more. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0274] It is outputted continuously. moreover, the period when the control gain accommodation signal which lowers the cutoff signal or control gain which stops actuation of said switching device in a breaker of operation at the time more than a fixed voltage level was defined beforehand -- at the time of slack Since it has the amendment machine which outputs correction value to said PWM controller so that the command electrical-potential-difference value or command current value of an PWM controller may be lowered, the count of cutoff of a switching device is reduced, the ripple of direct current voltage falls and a control system is stabilized more, supply of the direct current voltage stabilized more is attained. The count against [of a switching device 5] actuation becomes possible [decreasing and bringing the distorted input current close in the shape of a sine wave more] by that cause, and a power-factor can be improved more. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.

[0275] It sets to a breaker of operation further again. Above the 1st voltage level at the time under of the 2nd voltage level It is outputted continuously. the period when the control gain accommodation signal which lowers the cutoff signal or control gain which stops actuation of said switching device was defined beforehand -- at the time of slack Since it has the amendment machine which outputs correction value to said PWM controller so

that the command electrical-potential-difference value or command current value of an PWM controller may be lowered, the count of cutoff of a switching device is reduced, the ripple of direct current voltage falls and a control system is stabilized more, supply of the direct current voltage stabilized more is attained. The count against [of a switching device 5] actuation becomes possible [decreasing and bringing the distorted input current close in the shape of a sine wave more] by that cause, and a power-factor can be improved more. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0276] Moreover, since an PWM controller is equipped with the PI control section which carries out PWM control of the switching device, modification to the control gain according to a target electrical-potential-difference value of a control gain controller is attained since the signal to which either [at least] P gain of the PI control section or I gain is reduced is outputted, and the processing load in S/W is reduced, cost can be reduced more.
[0277] Furthermore, since an PWM controller is equipped with the electrical-potential-difference PI control section and the current PI control section which output the PWM output value which carries out PWM control of the switching device, modification to the control gain according to a target electrical-potential-difference value is attained since a control gain controller outputs the signal to which either [at least] the electrical-potential-difference PI control section or the current PI control section is reduced, and the processing load in S/W is mitigated, cost can be reduced more.
[0278] Moreover, intercepting actuation of a switching device 5, since it had the burden controller which outputs a signal to a load so that the load connected to the PWM control unit based on the output of a comparator might be increased, and it had the burden controller, by discharging direct current voltage, it becomes much more possible to reduce direct current voltage, and a much more reliable PWM control unit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0279] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller further again The electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the electrical-potential-difference level-setting machine set as a fixed voltage level, With the comparator which compares the fixed voltage level set up with this electrical-potential-difference level-setting vessel with the electrical potential difference detected by said electrical-potential-difference detector, when said detected electrical-potential-difference value is said more than fixed voltage level Since it had the burden controller which outputs a signal to a load so that the load linked to an PWM control unit might be increased Without suspending actuation of an PWM control unit, since direct current voltage is discharged, it becomes possible to protect an PWM control unit from an overvoltage, and a reliable PWM control unit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0280] Moreover, it sets to the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller. The electrical-potential-difference level-setting machine set to the electrical-potential-difference detector which detects the electrical potential difference outputted from said PWM control device, and the 1st voltage level and 2nd voltage level, Said detected electrical-potential-difference value with the comparator which compares said 1st and 2nd voltage level set up with this electrical-potential-difference level-setting vessel with the electrical-potential-difference value detected by said electrical-potential-difference detector above said 1st voltage level Have the burden controller which outputs a signal to a load so that the load linked to an PWM control unit may be increased at the time under of said 2nd voltage level, and when said detected electrical-potential-difference value is more than the 2nd voltage level, the output of said comparator Since it had the breaker of operation made to suspend actuation of said switching device, and the cutoff discharge machine of which cutoff of said breaker of operation is canceled Without usually suspending actuation of a power-factor-improvement circuit, since direct current voltage is discharged, a power-factor-improvement circuit can be protected from an overvoltage, even if a still

bigger overvoltage occurs, a power-factor-improvement circuit can be protected, and a reliable power-factor-improvement circuit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0281] In the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load furthermore, said inverter controller Since the energization phase angle which said inverter outputs to said motor is delayed based on the signal outputted from a burden controller Without suspending actuation of an PWM control unit, since direct current voltage is discharged, it becomes possible to protect an PWM control unit from an overvoltage, and a reliable PWM control unit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0282] In the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load moreover, said inverter controller Since it is made to make the rotational frequency which said inverter outputs to said motor increase based on the signal outputted from a burden controller Without suspending actuation of an PWM control unit, since direct current voltage is discharged, it becomes possible to protect an PWM control unit from an overvoltage, and a reliable PWM control unit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0283] In the PWM control-device protection network equipped with the inverter controller which controls the inverter and said inverter for motorised as a load further again said inverter controller Since it is made to make the applied voltage which said inverter outputs to said motor increase based on the signal outputted from a burden controller Without suspending actuation of an PWM control unit, since direct current voltage is discharged, it becomes possible to protect an PWM control unit from an overvoltage, and a reliable PWM control unit can be offered. Moreover, since it becomes actuation with a necessary minimum direct-current-voltage value, when the inverter which drives a motor is a load, efficient operation of the motor can be carried out, and an PWM control unit can also be operated with a well head.
[0284] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor moreover, said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The current detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the current which flows to said PWM control unit, The comparator which compares the current level-setting machine set as fixed current level with the fixed current level set up with this current level-setting vessel and the current value detected by said current detector, Since it had the breaker of operation which maintains a halt of said switching device of said PWM controller of operation when said detected current value was said more than fixed current level It is small and can consider as high performance and low loss, and dispersion in a gap is made few and engine-performance dispersion of a reactor also becomes small, and reliability is more high and it can protect from a sudden overcurrent. Moreover, even if it does not set up the 1st current level for performing cutoff of a temporary switching device 5 of operation, the shutdown of the PWM control unit by the overcurrent is avoidable, and since actuation continues, the dependability of an PWM control unit can also improve.
[0285] In the protection network of the PWM control unit which has one switching device which operates based on the actuating signal from an PWM controller, and reactor furthermore, said reactor The frame-like core which it becomes from two or more laminates, and a cross section becomes from the transversal frame core of the pair of a rectangle configuration, and the door-post core of a pair, The gap respectively prepared in the connection of the edge of said transversal frame core and door-post core, The electrical-potential-difference detector which is equipped with the coil of the pair ****(ed) by each of said transversal frame core or a door-post core, and detects further the electrical potential difference which flows to said PWM control unit, The comparator which compares the electrical-potential-difference level-setting machine set as a fixed voltage level with the fixed voltage level set up with this electrical-potential-difference level-setting vessel and the electrical-

potential-difference value detected by said electrical-potential-difference detector, Since it had the breaker of operation which maintains a halt of said switching device of said PWM controller of operation when said detected electrical-potential-difference value was said more than fixed voltage level A reactor can be miniaturized and a sudden overcurrent can be controlled with a cheap reactor. Even if it does not set up the 1st current level for performing cutoff of a temporary switching device 5 of operation, the shutdown of the PWM control unit by the overcurrent can be avoided, and the dependability of an PWM control unit can also improve.
[0286] Moreover, since thickness used the laminate as the magnetic-substance ingredient which is the high permeability of 0.2mm or less, it can reduce loss, can control the degradation of the reactor by generation of heat, and can protect it from a sudden overcurrent better.
[0287] Since the door-post core and the transversal frame core were arranged further again using the quality of a magnetic matter which has directivity in a laminate so that the direction where magnetic flux flows might intersect perpendicularly with a transversal frame core and a door-post core, loss can be reduced, the degradation of the reactor by generation of heat can be controlled, and it can protect from a sudden overcurrent better.
[0288] Moreover, since the connection made the edge of a transversal frame core and a door-post core the field which makes the supplementary angle of each other to shaft orientations respectively, loss by magnetic reluctance can become small, and it can reduce loss, can control the degradation of the reactor by generation of heat, and can protect it from a sudden overcurrent better.
[0289] Furthermore, since the connection considered as the right-angled end face to the shaft orientations of an parallel side face and the edge of a door-post core to the shaft orientations of the edge of a transversal frame core, production of a transversal frame core and a door-post core can be made easy to carry out.
[0290] Since the die length of a door-post core was made into a-2b further again when thickness of the rectangular direction of the plane of composition of a and a transversal frame core was set to b for the die length of a transversal frame core, it can be made small.
[0291] Moreover, since the transversal frame core and the door-post core were made into the same die length, production of a transversal frame core and a door-post core can be made easy to carry out.
[0292] Moreover, since the coil of a pair was made into the juxtaposition volume, splitting of the current which flows to a coil can be carried out, it can consider as the low loss reactor which reduced loss by resisted part, the degradation of the reactor by generation of heat can be controlled, and it can protect from a sudden overcurrent.
[0293] Furthermore, since the coil of a pair was made into the serial volume, it becomes possible to reduce the number of turns per one side of frame-like cores, and can protect from a sudden overcurrent by giving allowances to the magnetic saturation in a frame-like core.

[Translation done.]

* NOTICES *

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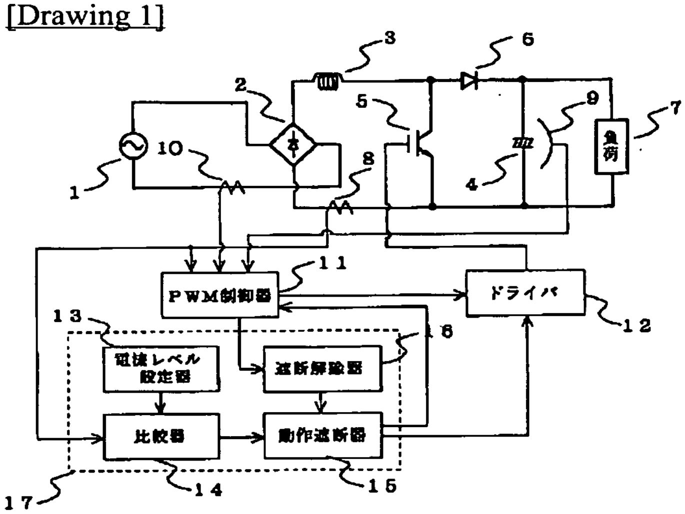
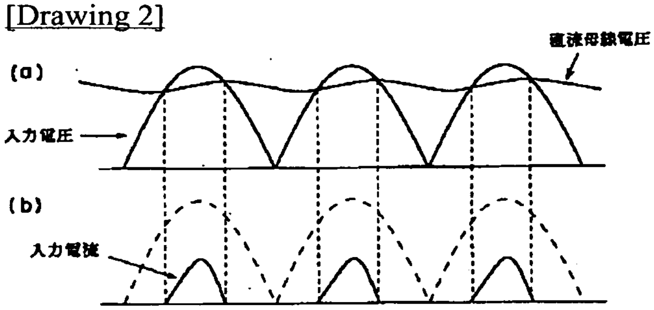
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

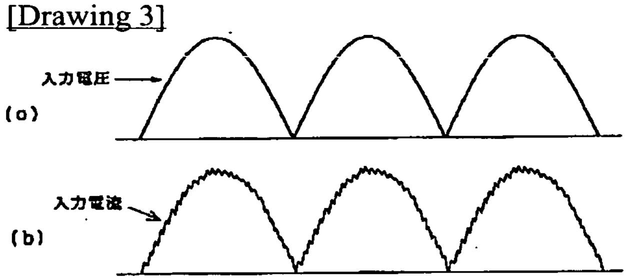
[Drawing 1]



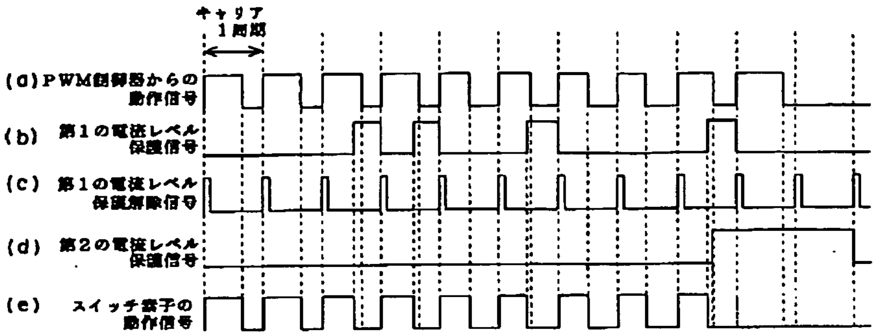
[Drawing 2]



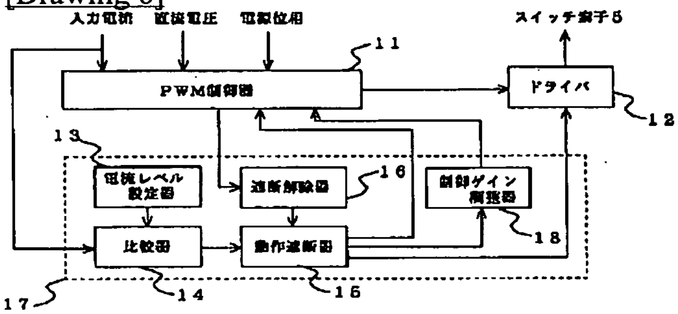
[Drawing 3]



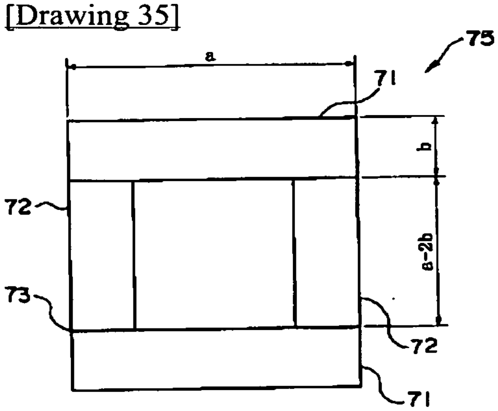
[Drawing 5]



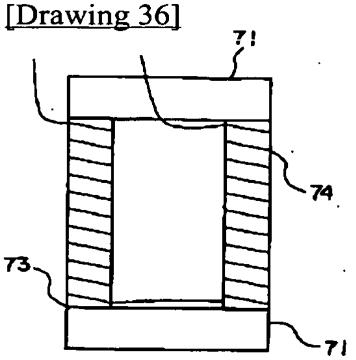
[Drawing 6]



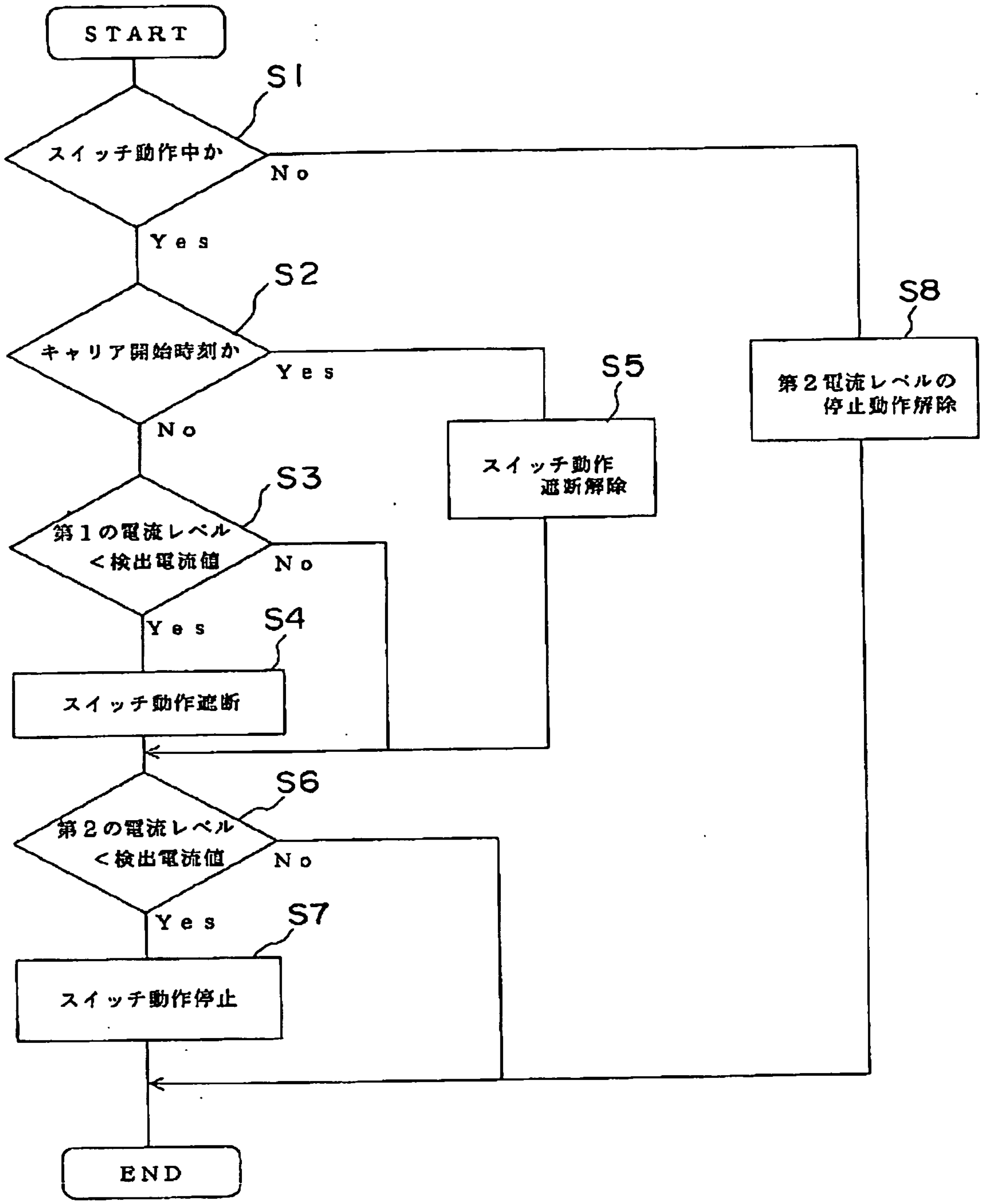
[Drawing 35]



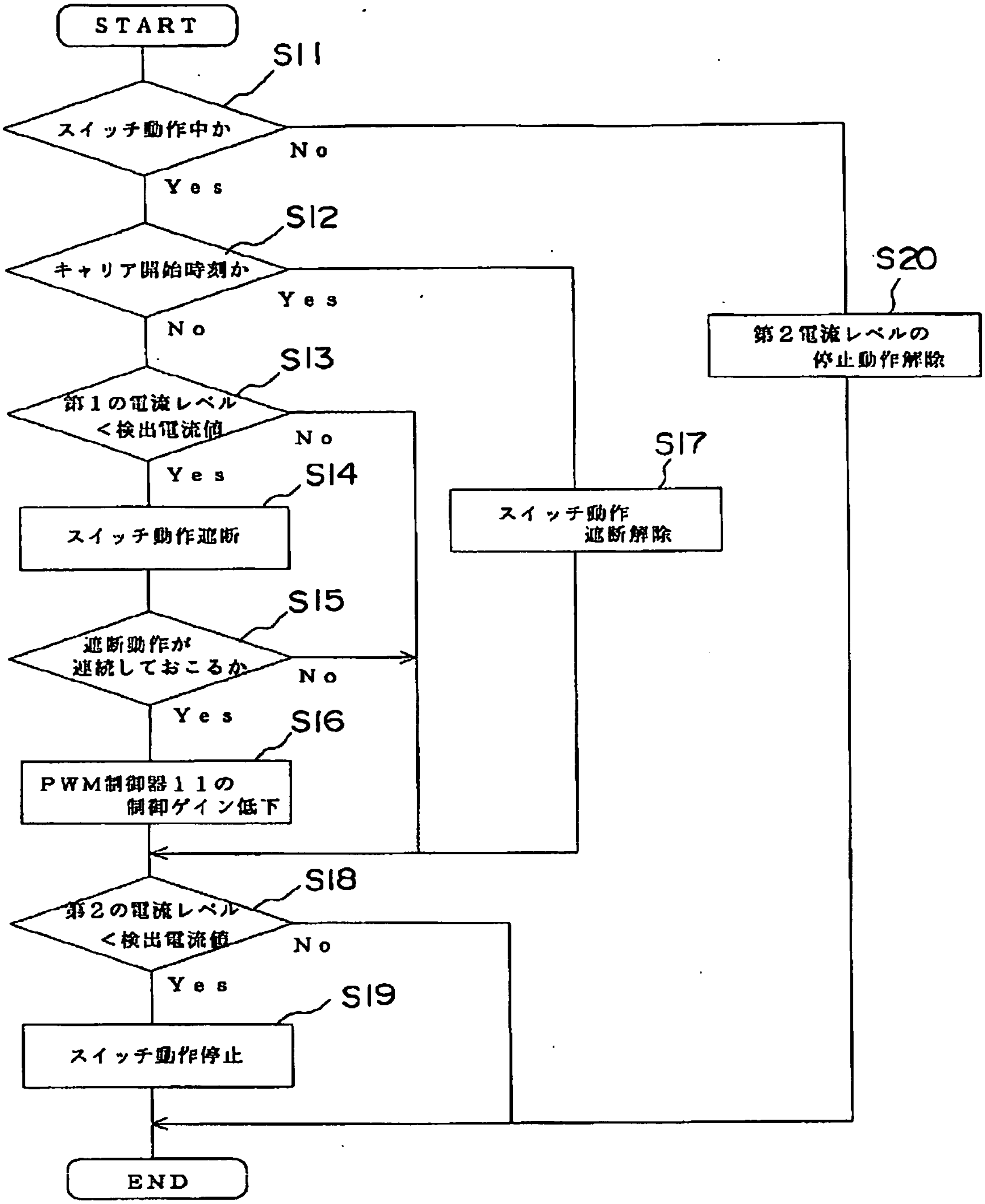
[Drawing 36]



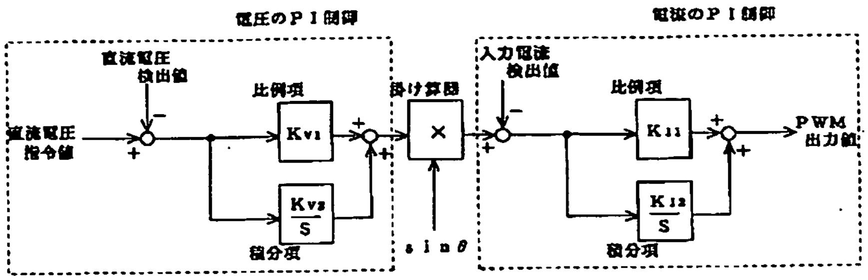
[Drawing 4]


START
S1
スイッチ動作中か
No
Yes
S2
キャリア開始時刻か
Yes
No
S3
第1の電流レベル
<検出電流値
No
Yes
S4
スイッチ動作遮断
S5
スイッチ動作
遮断解除
S8
第2電流レベルの
停止動作解除
S6
第2の電流レベル
<検出電流値
No
Yes
S7
スイッチ動作停止
END

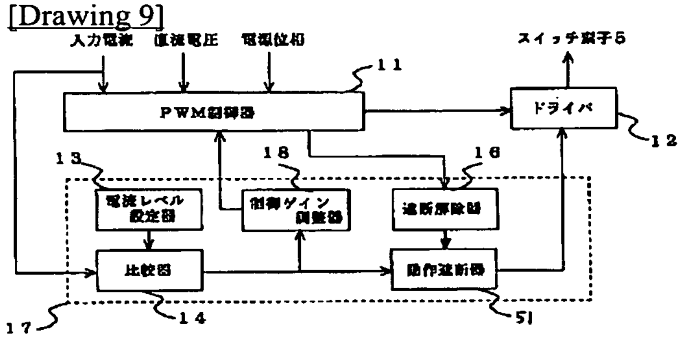
[Drawing 7]


START
S11
スイッチ動作中か
No
Yes
S12
キャリア開始時刻か
Yes
No
S13
第1の電流レベル
<検出電流値
No
Yes
S14
スイッチ動作遮断
S15
遮断動作が
連続しておこるか
No
Yes
S16
PWM制御器11の
制御ゲイン低下
S17
スイッチ動作
遮断解除
S20
第2電流レベルの
停止動作解除
S18
第2の電流レベル
<検出電流値
No
Yes
S19
スイッチ動作停止
END

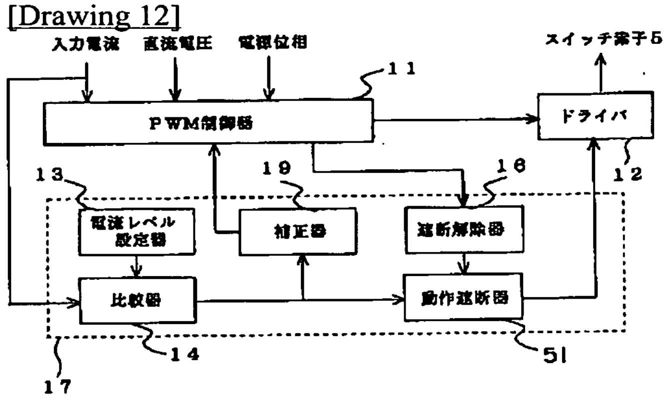
[Drawing 8]



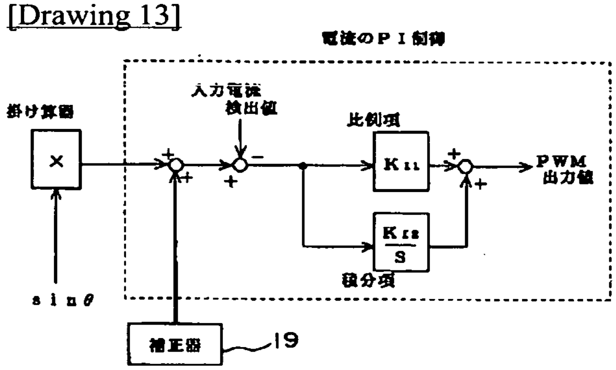
[Drawing 9]



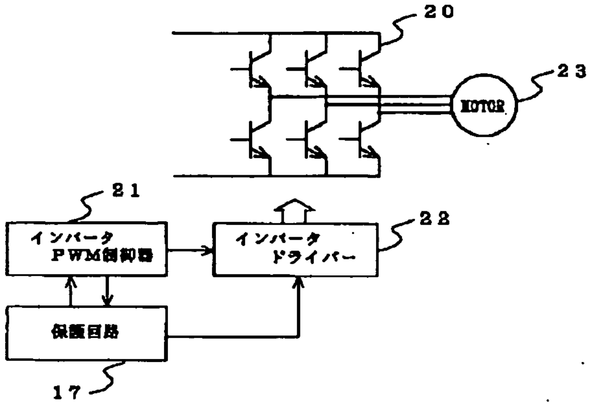
[Drawing 12]



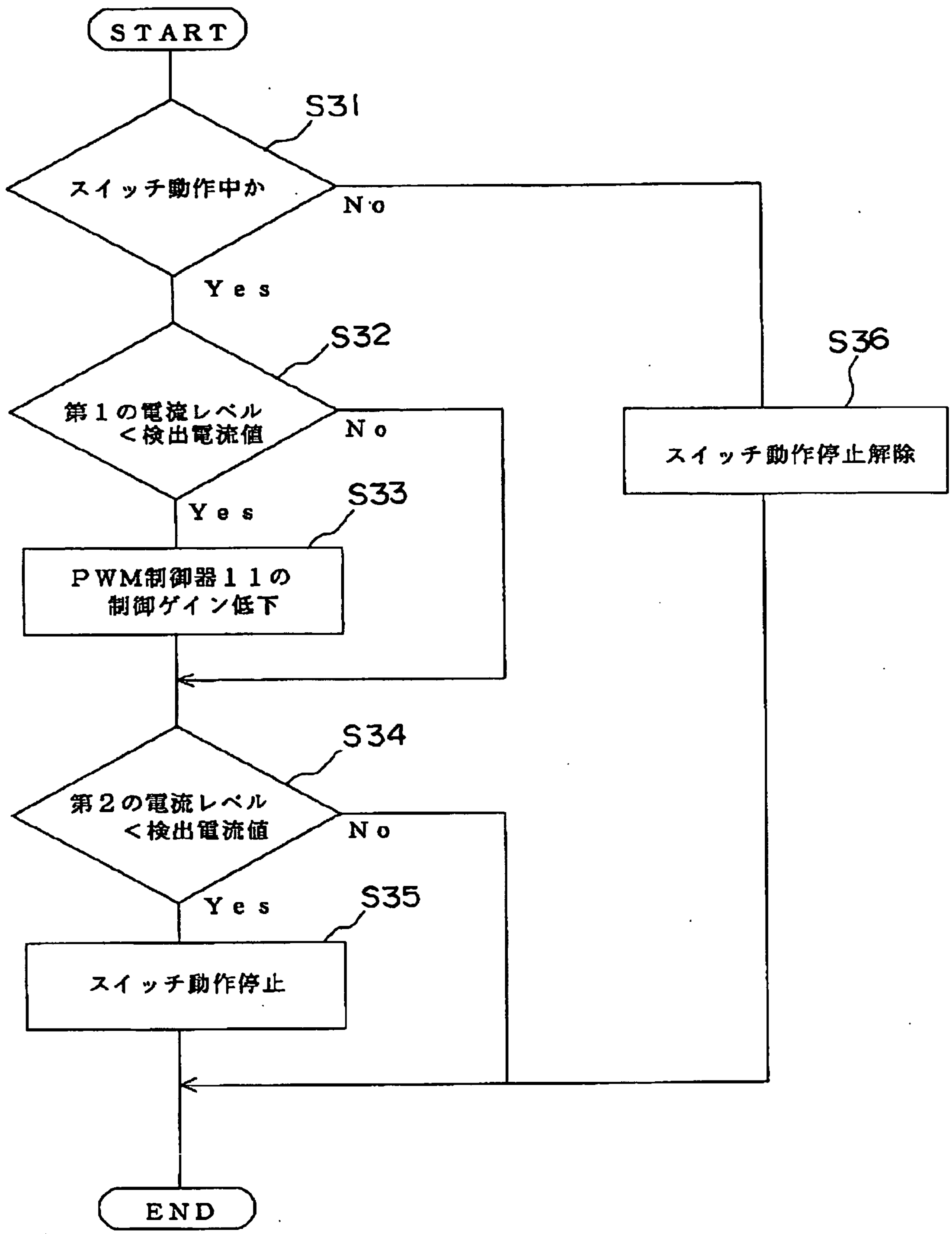
[Drawing 13]



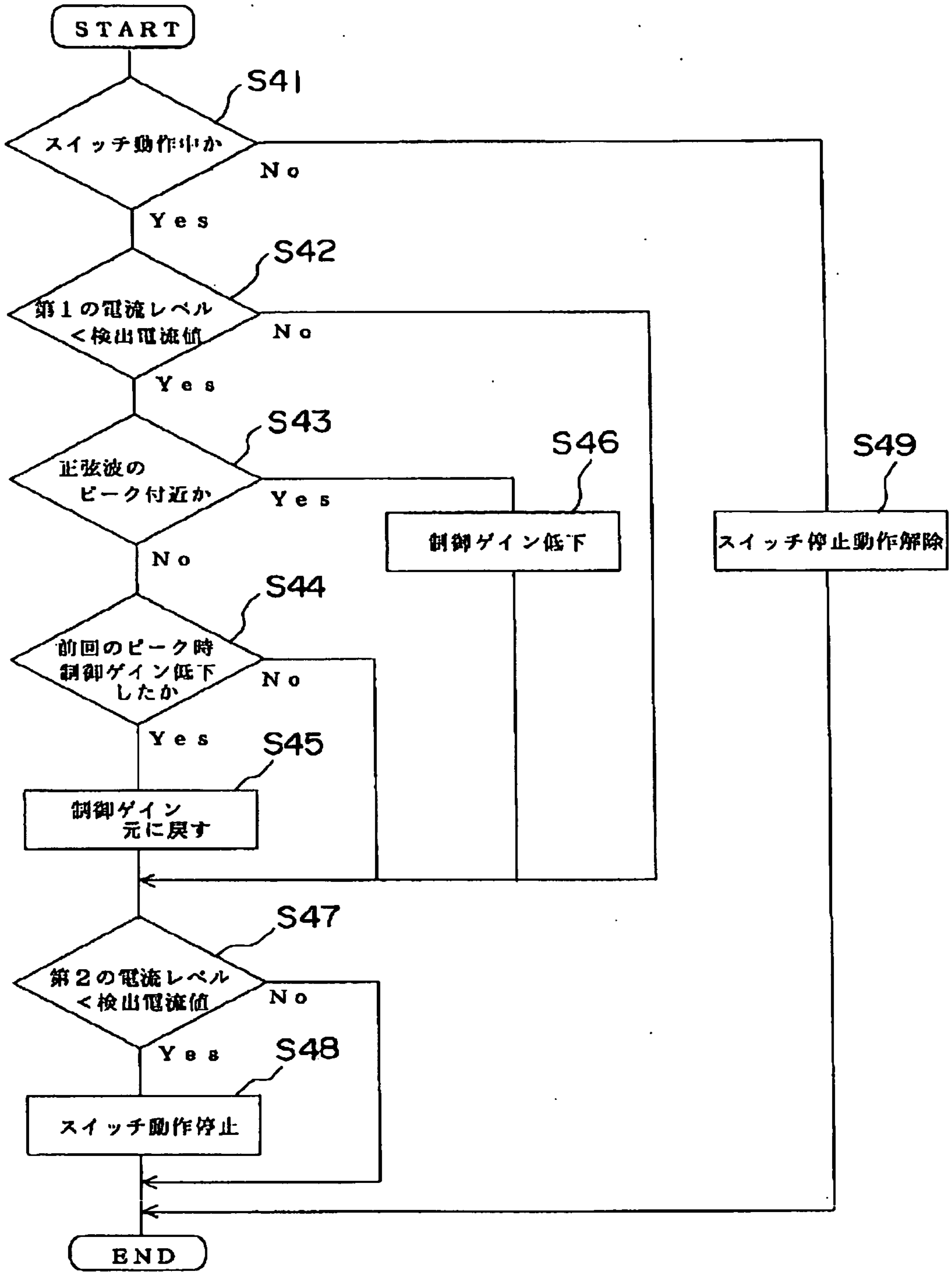
[Drawing 14]



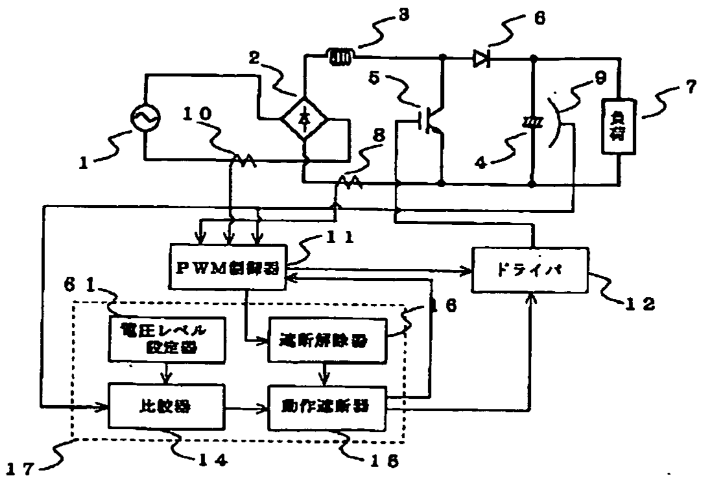
[Drawing 10]


START
S31
スイッチ動作中か
No
Yes
S32
第１の電流レベル
＜検出電流値
No
Yes
S33
ＰＷＭ制御器１１の
制御ゲイン低下
S34
第２の電流レベル
＜検出電流値
No
Yes
S35
スイッチ動作停止
S36
スイッチ動作停止解除
END

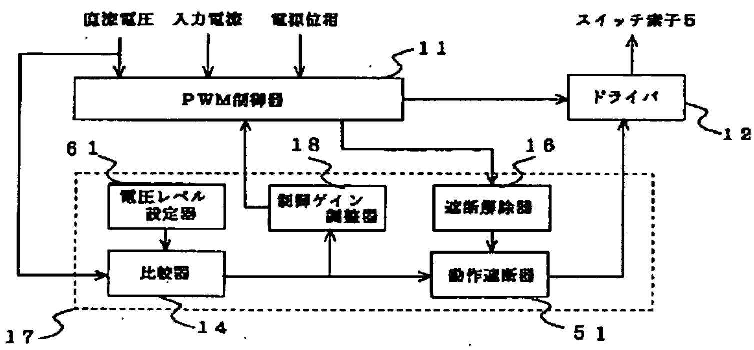
[Drawing 11]


START
S41
スイッチ動作中か
No
Yes
S42
第1の電流レベル
<検出電流値
No
Yes
S43
正弦波の
ピーク付近か
Yes
S46
制御ゲイン低下
S49
スイッチ停止動作解除
No
S44
前回のピーク時
制御ゲイン低下
したか
No
Yes
S45
制御ゲイン
元に戻す
S47
第2の電流レベル
<検出電流値
No
Yes
S48
スイッチ動作停止
END

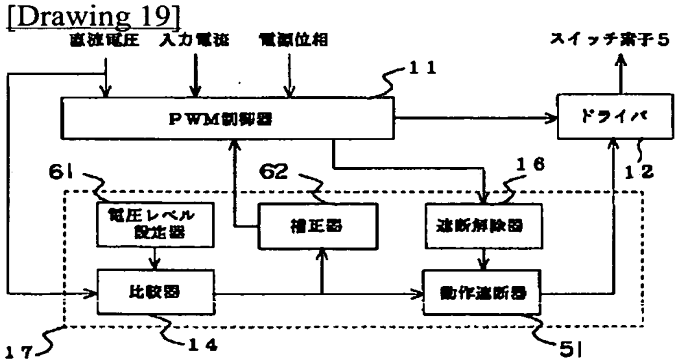
[Drawing 15]



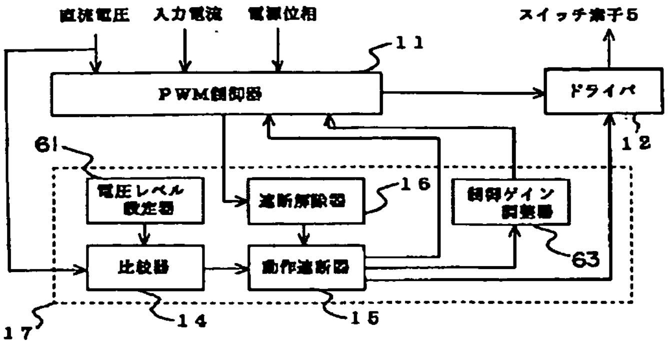
[Drawing 17]



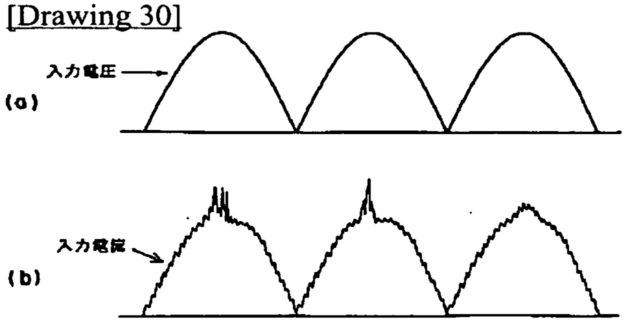
[Drawing 19]



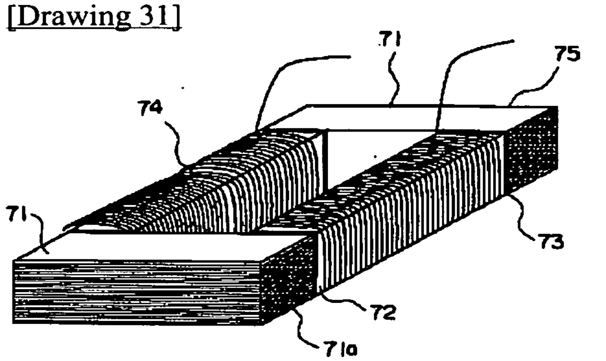
[Drawing 21]



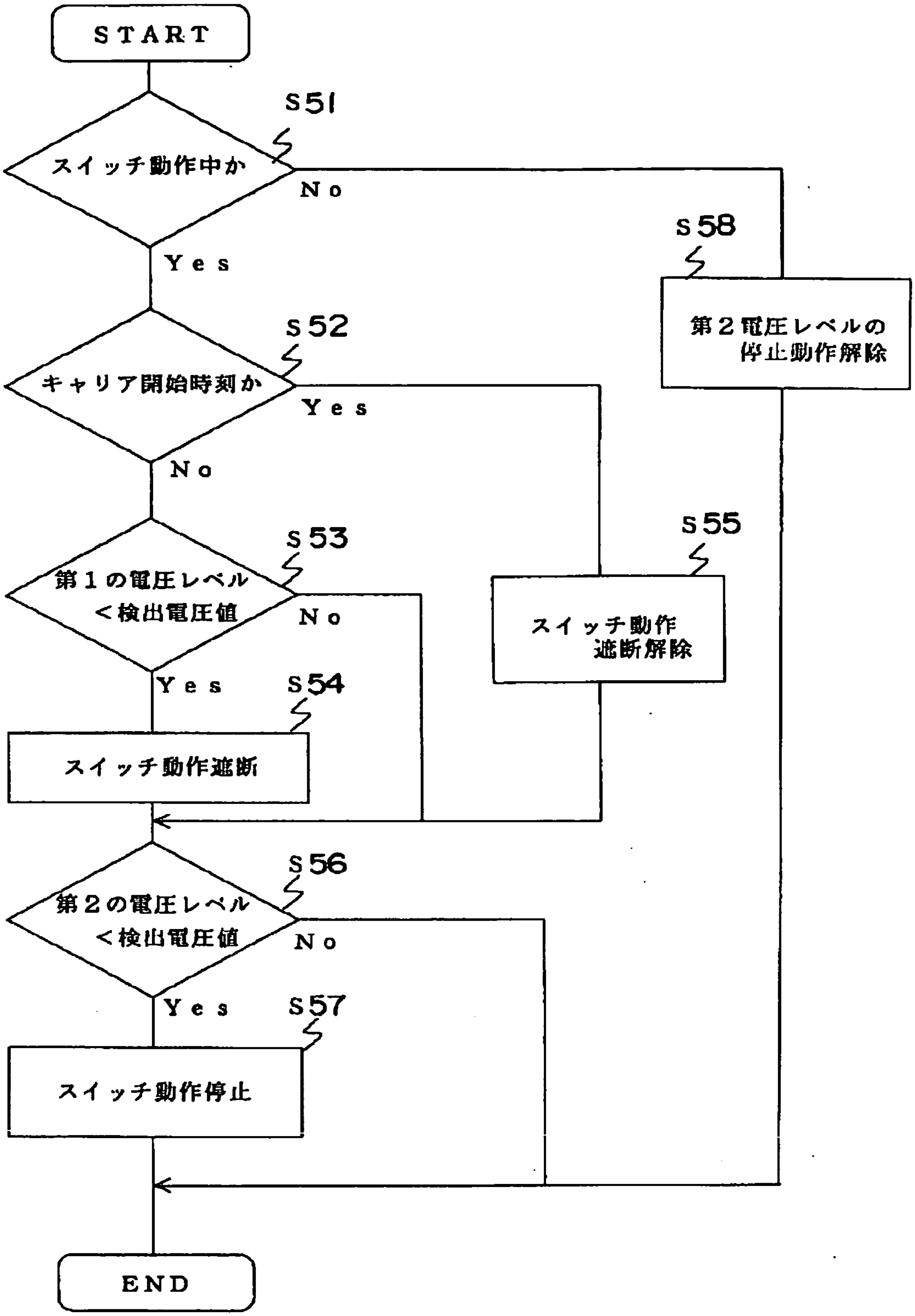
[Drawing 30]



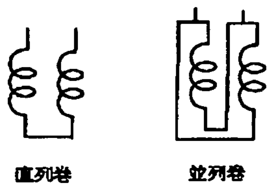
[Drawing 31]



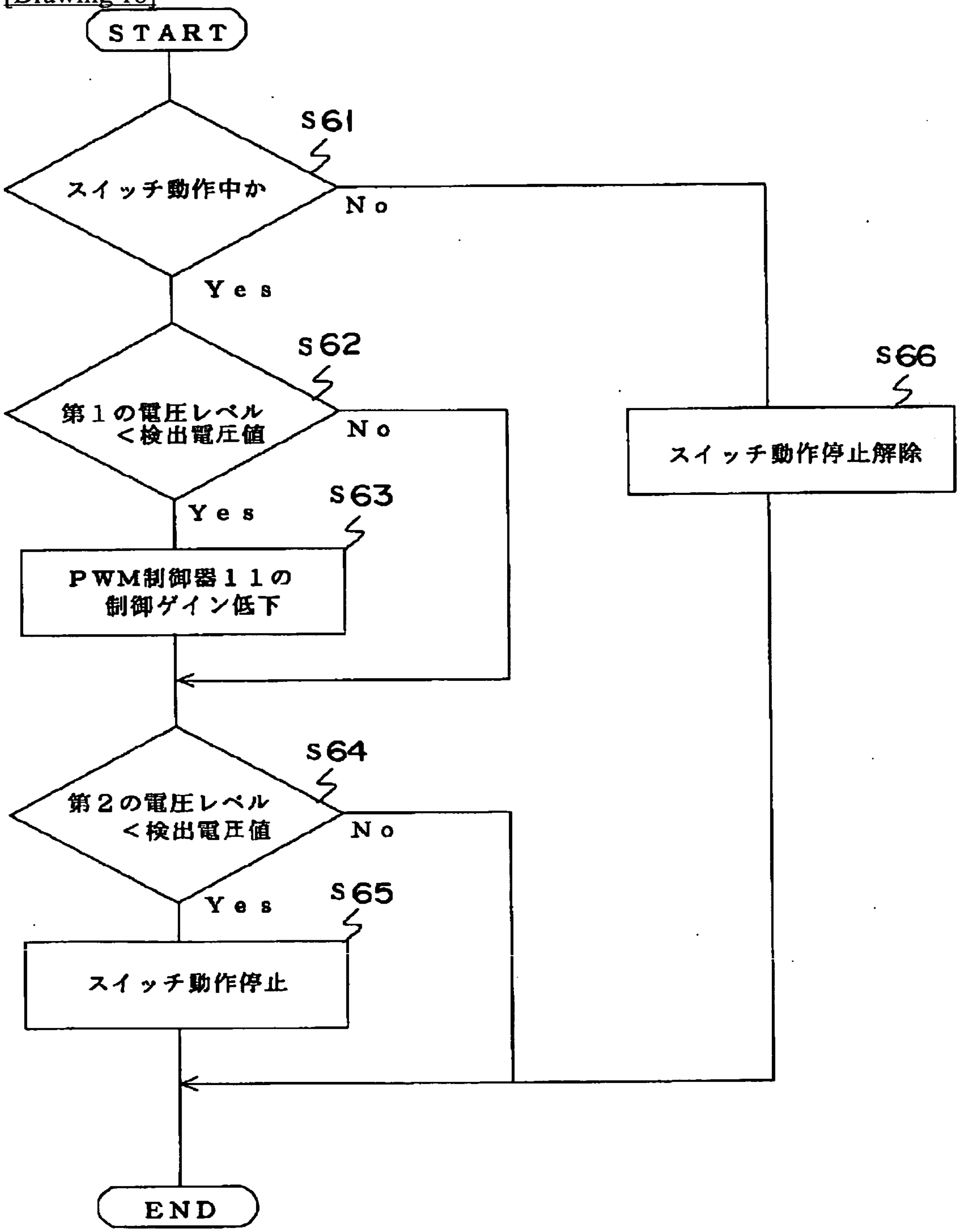
[Drawing 16]


START
S51
スイッチ動作中か
No
Yes
S58
第２電圧レベルの
停止動作解除
S52
キャリア開始時刻か
Yes
No
S55
S53
第１の電圧レベル
＜検出電圧値
No
スイッチ動作
遮断解除
Yes
S54
スイッチ動作遮断
S56
第２の電圧レベル
＜検出電圧値
No
Yes
S57
スイッチ動作停止
END

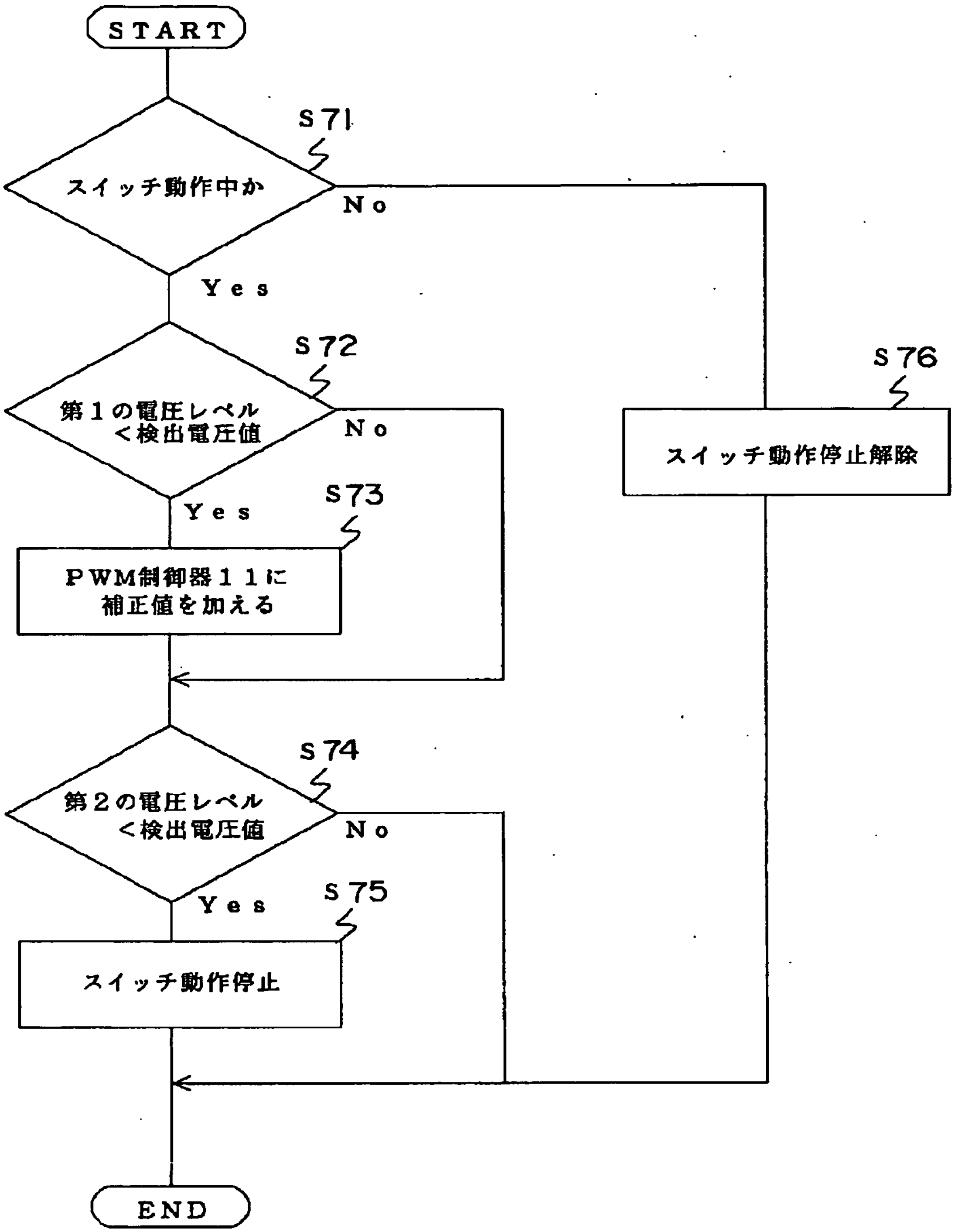
[Drawing 38]



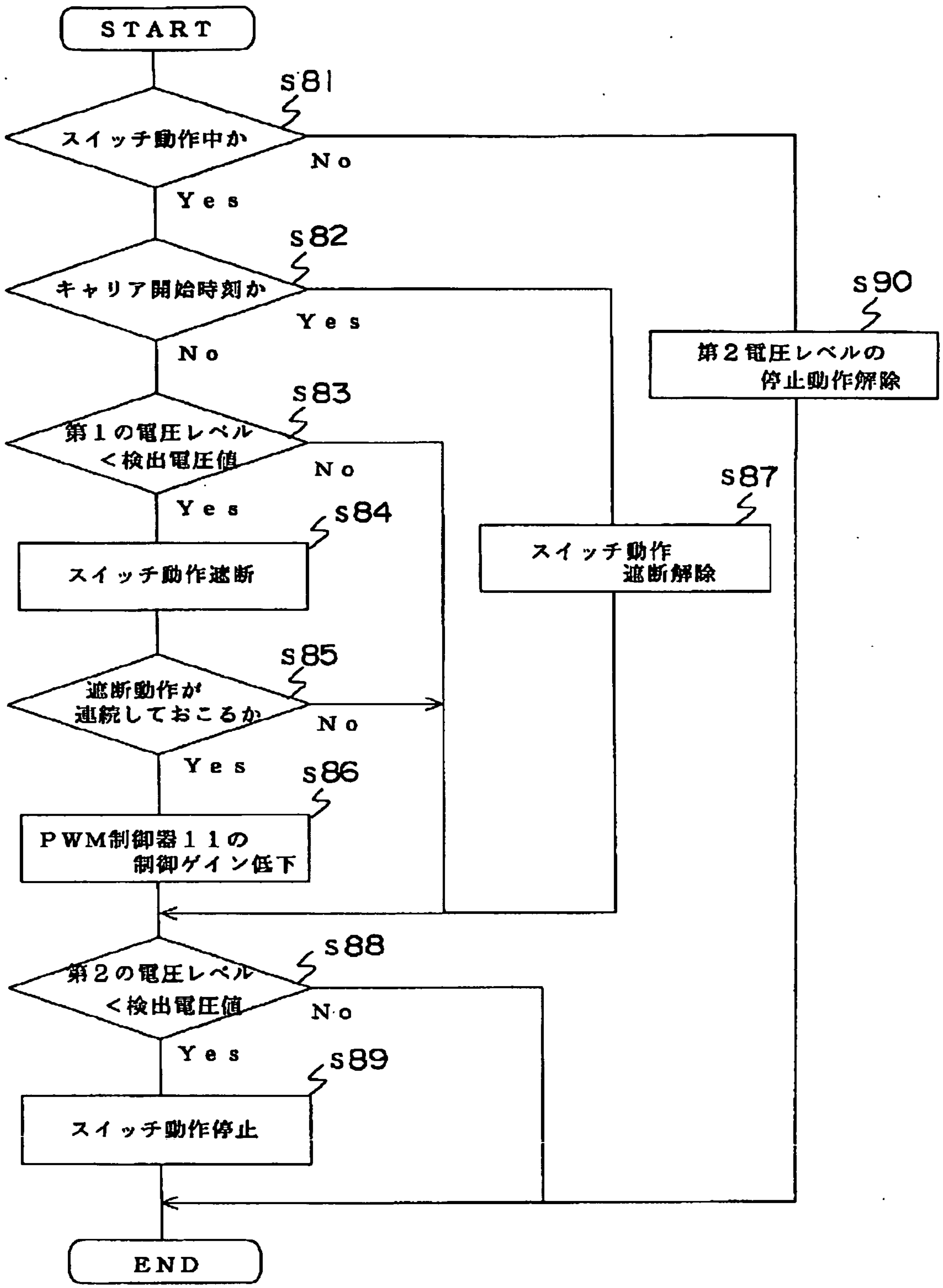
[Drawing 18]



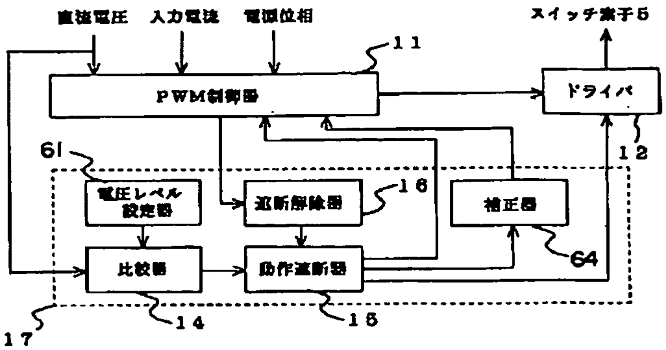
[Drawing 20]


START
S71
スイッチ動作中か
No
Yes
S72
第１の電圧レベル
＜検出電圧値
No
Yes
S73
ＰＷＭ制御器１１に
補正値を加える
S74
第２の電圧レベル
＜検出電圧値
No
Yes
S75
スイッチ動作停止
S76
スイッチ動作停止解除
END

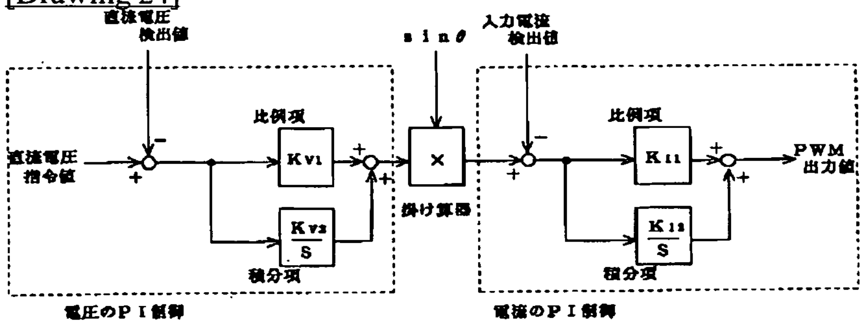
[Drawing 22]


START
s81
スイッチ動作中か
No
Yes
s82
キャリア開始時刻か
Yes
No
s83
第１の電圧レベル
＜検出電圧値
No
Yes
s84
スイッチ動作遮断
s85
遮断動作が
連続しておこるか
No
Yes
s86
ＰＷＭ制御器１１の
制御ゲイン低下
s87
スイッチ動作
遮断解除
s88
第２の電圧レベル
＜検出電圧値
No
Yes
s89
スイッチ動作停止
s90
第２電圧レベルの
停止動作解除
END

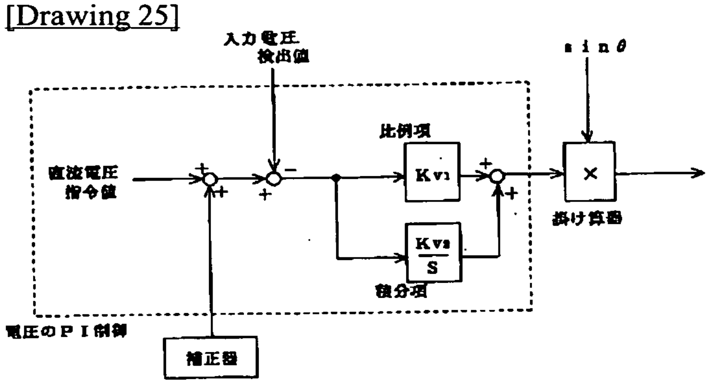
[Drawing 23]



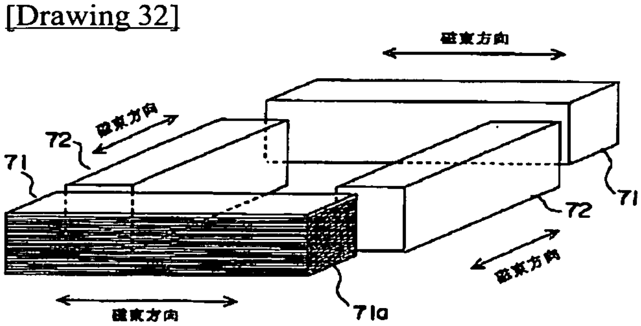
[Drawing 24]



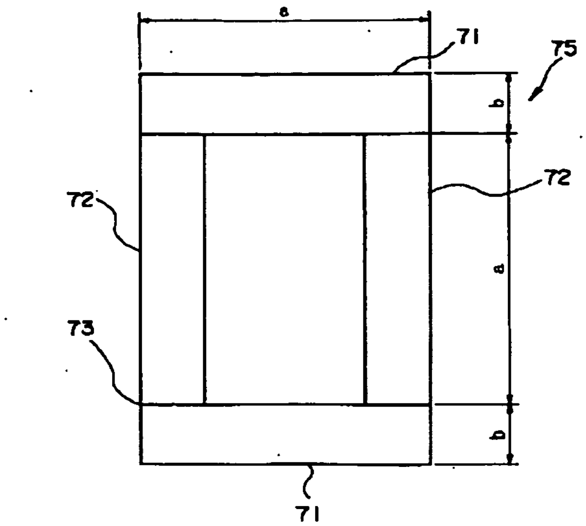
[Drawing 25]



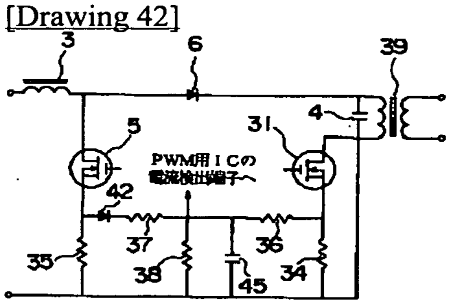
[Drawing 32]



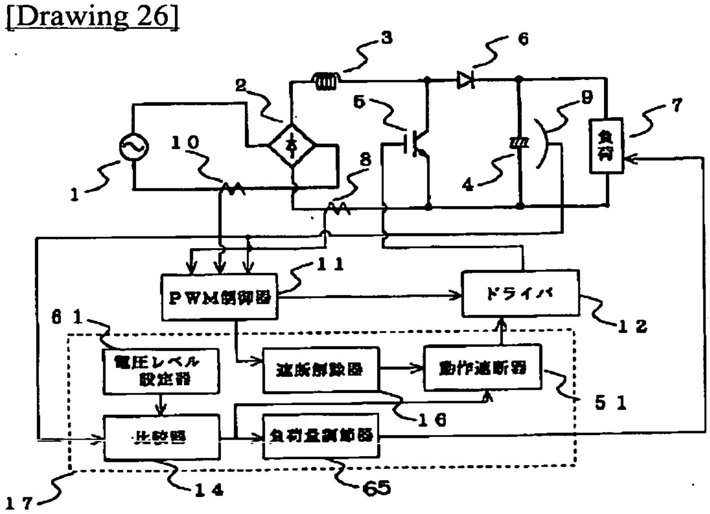
[Drawing 33]



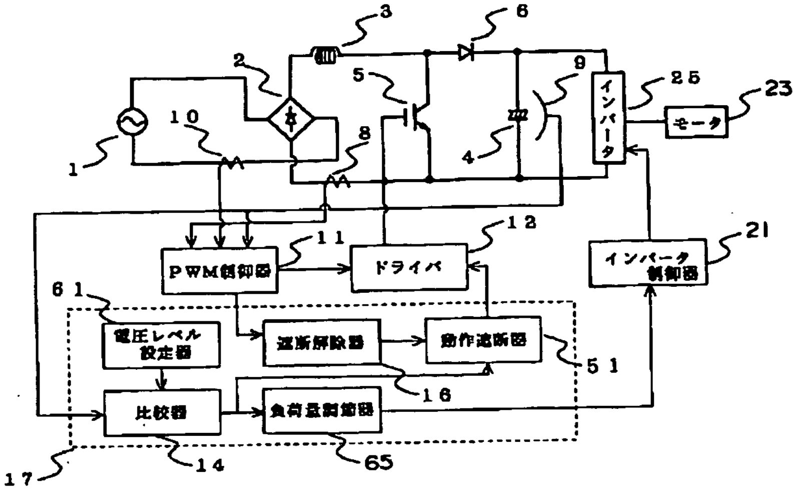
[Drawing 42]



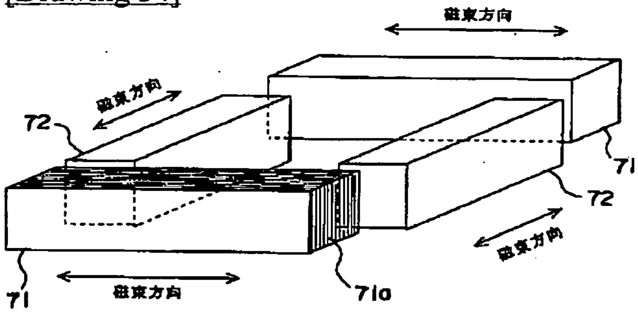
[Drawing 26]



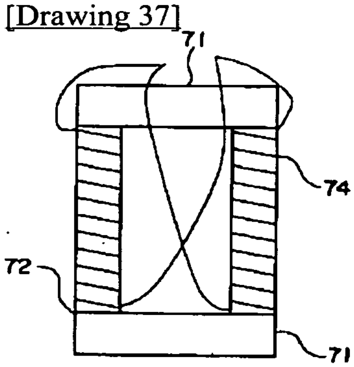
[Drawing 27]



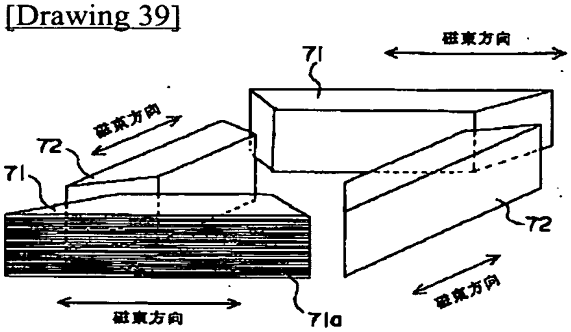
[Drawing 34]



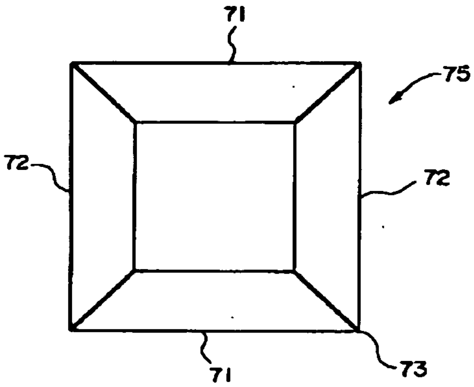
[Drawing 37]



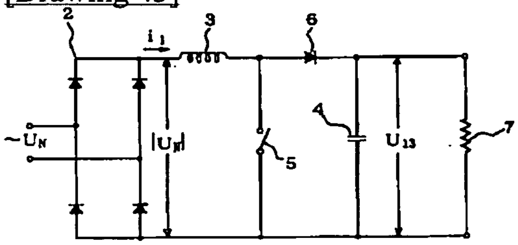
[Drawing 39]



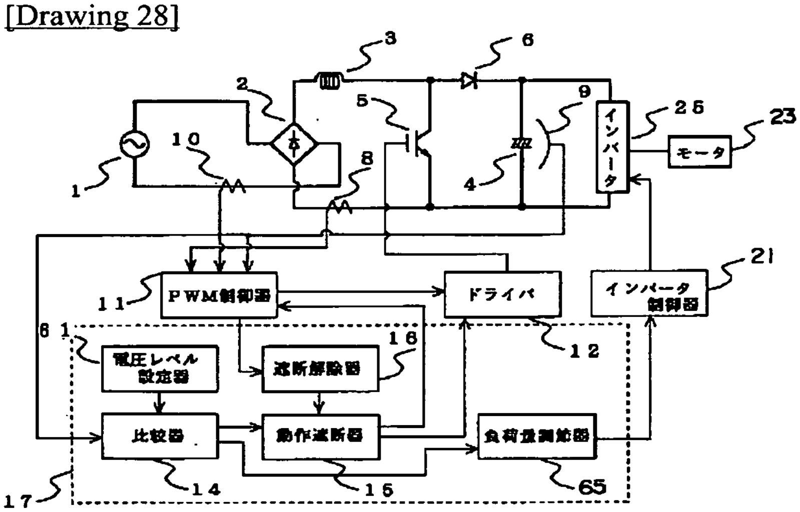
[Drawing 40]



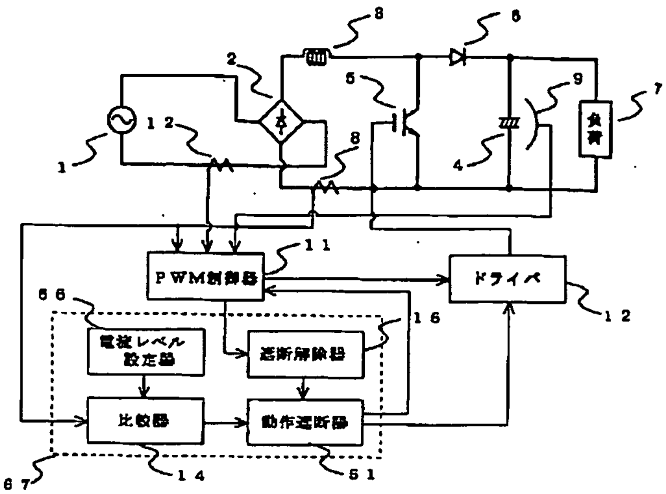
[Drawing 43]



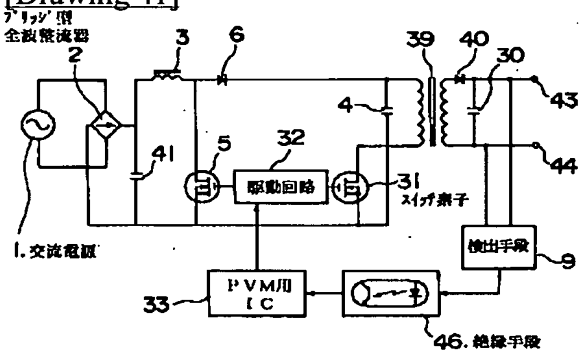
[Drawing 28]



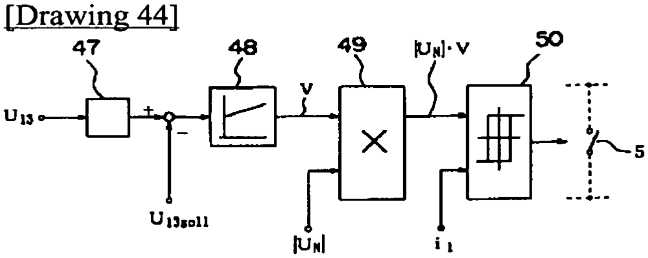
[Drawing 29]



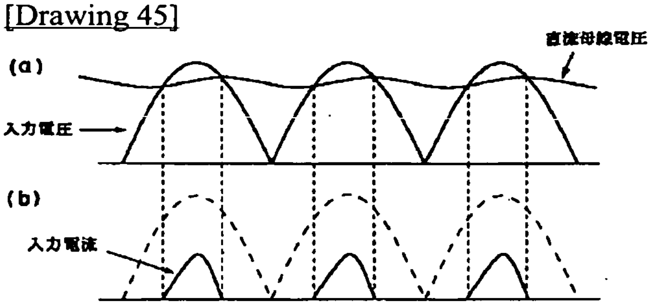
[Drawing 41]



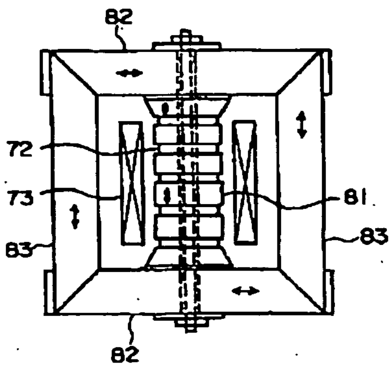
[Drawing 44]



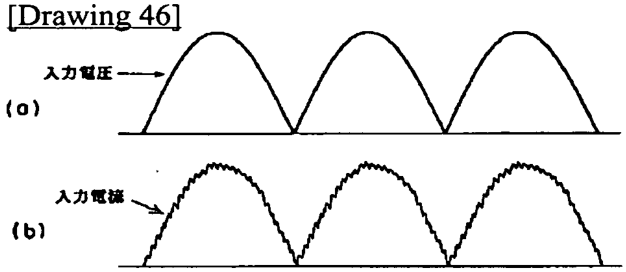
[Drawing 45]



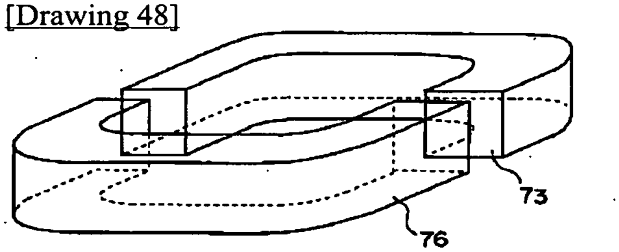
[Drawing 47]



[Drawing 46]



[Drawing 48]



[Translation done.]